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IN THE

# Supreme Court of the United States

OCTOBER TERM, 1968.

No. 664

RANSBURG ELECTRO-COATING CORP.,

*Petitioner,*

*vs.*

IONIC ELECTROSTATIC CORPORATION,

*Respondent.*

## APPENDIX TO PETITION FOR WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FOURTH CIRCUIT

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IN THE

# United States Court of Appeals

FOR THE FOURTH CIRCUIT

RANSBURG ELECTRO-COATING CORP., *Appellee,*

vs.

IONIC ELECTROSTATIC CORPORATION, *Appellant.*

No. 10,347

**APPEAL FROM THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF MARYLAND, AT BALTIMORE. R. DORSEY WATKINS, DISTRICT JUDGE.**

(Argued May 5, 1966. Decided April 11, 1968.)

Before HAYNSWORTH, Chief Judge, and BOREMAN and J. SPENCER BELL,* Circuit Judges.

HAYNSWORTH, Chief Judge:

The defendant has appealed from an order holding it in contempt of an injunctive order entered in a patent case. The contempt finding is premised upon a finding that certain devices for use in electrostatic spray painting systems are the equivalent of certain other devices previously found to infringe the plaintiff's patents and that the sale and use of the new devices were proscribed by the terms of the injunction. In light of the prior art, which the patentee has no right to appropriate, we think the finding erroneous.

* Judge J. Spencer Bell participated in the hearing of this case and expressed general approval of the result, but died before the opinion was prepared.

Plaintiff's patents cover paint feeding mechanisms in which paint is delivered to atomizing heads connected with one terminal of a high voltage source on the order of 90,000 volts, creating an electrostatic field between the head and the grounded objects to be painted. The electrostatic forces atomize the paint into small droplets, each highly charged with negative ions, and the electrostatic field deposits them on the work. The defendant's devices with which we are now concerned have insulated or nonconductive heads unconnected to any power source. Rotated at speeds up to 21,000 r.p.m., atomization of the paint is essentially centrifugal, but the head itself is within an electrostatic field created by a discharging electrode electrically connected to a high voltage source from which the uncharged head acquires a static charge equal to that of any other object within the electrostatic field along the same line of force. Whether the plaintiff's patent and the injunction against its infringement can reach the defendant's devices in which the atomizing head is not the discharging electrode is the essential question.

Some reference to the prior art is essential to an understanding of the problem.

Spray painting has long been known. Compressed air has long been used for breaking paint into fine droplets, known in the trade as "atomizing," on the same principle as employed in ladies' perfume bottles, insecticide spray cans and a multitude of household and industrial devices. Air spray guns are still used for a multitude of purposes, including very fine finishing, though airless guns have been developed with nozzles which achieve atomization of paint delivered under pressure for use in such finishing.[1]

Outside of the fine furniture field, however, the use of

[1] See Gray Co. v. Spee-Flo Mfg. Corp., 5 Cir., 361 F.2d 489.

air spray guns for most industrial painting was wasteful of material, particularly when the objects to be painted were a succession of objects moving along a production line. There were other obvious disadvantages, for there was not only a waste of paint, but a collection of unwanted paint on other objects within the range of the sprayer.

This led to the introduction of electrostatic fields by connecting a discharging electrode to one side of a high voltage source and connecting the other side to the work to be painted or to the ground, in which event the work to be painted was grounded. Paint atomized in an air spray or centrifugally when introduced into such an electrostatic field picked up static charges from the field, which tended to make particles repel each other while each was being attracted to the work. This system was referred to for convenience as "Ransburg No. 1," for the plaintiff has long been prominent in this area and holds a number of expired patents upon variants of the general prior art system.

For the uses for which we are now concerned, the Ransburg No. 1 system was a substantial improvement over the use of spray guns without the assistance of the electrostatic field. It greatly reduced the waste of paint and its deposition upon unwanted material, but it did not entirely eliminate it. Some particles of paint acquired such great velocities that the forces in the electrostatic field were of insufficient strength to control their movement.

Ransburg then developed its No. 2 system represented by the patents in suit.[2] Under this system paint is fed at a controlled rate to a stationary head or one revolving at a relatively low speed for the sole purpose of delivering the

[2] There are separate patents representing different forms of discharging heads, but for our present purposes they all incorporate and exemplify the same principle.

paint in a film to the edge of the rotating head. The head itself is directly connected to the negative terminal of high voltage source, however, which makes the head the discharging electrode. There is thus created an electrostatic field between the head, as the discharging electrode, and the work which, with 90,000 volts, is itself effective to break up the paint into fine particles and move the particles through the electrostatic field and deposit them on the work. The field is quite comparable to an electromagnetic field, which we have all observed with the use of iron filings, and is quite effective to deposit paint on all sides of such objects as broom handles.

The Ransburg No. 2 system is quite effective in overcoming the disadvantages of the No. 1 system. Waste is completely eliminated, or almost completely so, and the particles of the paint are finer and much more uniform than in the previous system as practiced before Ransburg No. 2 was developed. This was because no other forces than the electrostatic field were acting upon the particles to give them velocity and because the initial negative charge of each particle was substantially the same as that delivered directly to the discharging head by the power source. Inventiveness was said to lie essentially in use of the head as the discharging electrode and in the concept of achieving atomization by electrostatic forces rather than by the mechanical forces theretofore employed.

With general success, Ransburg asserted its patents on the No. 2 system against copyists defending on the ground of patent invalidity because of obviousness and non-infringement because in the accused devices atomization of the paint was achieved by a combination of mechanical and electrostatic forces.[3] These were the original questions in

[3] Ransburg Electro-Coating Corp. v. Proctor Electric Co., 4 Cir., 317 F.2d 302; Binks Mfg. Co. v. Ransburg Electro-Coating Corp.,

this action, for the defendant had marketed spray guns with a spray head connected directly to a high voltage source, but rotating at speeds in the order of 900 r.p.m. so that atomization of the paint was the product of mechanical, as well as electrostatic forces. The District Court found the patents valid, and applied to them the "broad," not the "narrow"[4] construction to find infringement as long as the electrostatic forces played a substantial, though not an exclusive, part in the atomization of the paint.[5] We affirmed on the opinion of the District Court,[6] and that seems to be the consensus,[7] for Ransburg's patents are entitled to a sufficiently broad construction that they may not be practiced by the introduction of contributory forces which do not remove dependence upon the electrostatic forces for the atomization of the paint. It was found to have been quite enough if atomization of the paint had been accomplished through the teachings of the patent, though other available means to that end were also employed.

Appropriately, an injunction was issued against further infringement by Ionic. Meanwhile, however, Ionic had brought out three new models in which there is no direct connection between the atomizing head and the power source and in which, it is contended, electrostatic forces play no part in the atomization of the paint.

Because of these new models, of which Ransburg had general information, the defendant, Ionic, insisted that the injunctive decree be phrased in terms of the court's exposi-

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7 Cir., 281 F.2d 252; Ransburg Electro-Coating Corp. v. Williams, W. D. Ark., 246 F. Supp. 626; Ransburg Electro-Coating Corp. v. Ford Motor Co., S. D. Ind., 245 F. Supp. 308.

[4] See Ransburg v. Aerostyle Ltd., [1968] ... A.C. ....

[5] Ransburg Electro-Coating Corp. v. Proctor Electric Co., D. Md., 203 F. Supp. 235.

[6] Ransburg Electro-Coating Corp. v. Proctor Electric Co., 4 Cir., 317 F.2d 302.

[7] See cases cited in notes 3 and 4.

tion of the essence of the invention, rather than by general reference to the patent. Consequently, the debate in the District Court on the contempt proceeding and here has been framed principally in terms of the injunctive order, without regard to the availability of the prior art to any practitioner.

The District Court found, within the terms of the injunctive order, that the presently accused devices achieve atomization of the paint, at least in part, electrostatically, that there is an electrostatic field between the atomizing head and the work sufficient to disperse and deposit the paint and that atomization is achieved at the point of highest concentration of forces in the electrostatic field.[8]

While we need not examine these findings *seriatim,* some comments are not inappropriate.

From high speed photographs, there was uncontroverted evidence that there was no discernible difference in the atomization of the paint with the field on and off. It was all mechanical. The plaintiff contended, however, that a test showed that if Ionic's heads were slowed from their extraordinarily high rotational speeds to zero and the feeding of the paint was stopped, there was evidence of the force of the electrostatic field. Of course, there was. This was a natural phenomenon, long observed, and employed in this industry to remove excess paint. Known as "detearing," it had been long employed to draw off excessive paint from objects to be coated. This application of the detearing principle when the accused device was stationary and with no paint feeding to it, proves little.

The plaintiff also offered evidence through strip tests that, while the particles into which the paint was atomized by Ionic's centrifugal guns were more than acceptably

[8] Ransburg Electro-Coating Corp. v. Proctor Electric Co., D. Md., 242 F. Supp. 28.

small and uniform with the electrostatic field off, they were still smaller with the electrostatic field on. It was contended that these strip tests showed that electrostatic forces played some part in the atomization of the paint and that it was not achieved exclusively by the centrifugal forces. The contention gives no weight to the fact that the uncharged atomized particles would tend to conglomerate, while in the presence of an electrostatic field each would tend to repel each other particle.

In the accused devices there is no doubt that the atomizing head is not the discharging electrode. The electrode is a separate grid or ring from which the atomizing head is insulated, and the head, usually, is of non-conductive material. Nevertheless, because the insulated or non-conductive head is within the electrostatic field created by the separate electrode, the head itself acquires a static charge equal to that of every other object within the electrostatic field along the same gradient. The static charge on the head is substantially less than the active charge on the electrode, but there is still a substantially high voltage varying between approximately 14,500 volts on the Model 10 to 32,000 volts on the Model 25.

The presence of this floating, static charge on the head is the basis for contentions by the plaintiff that there is an appreciable, separate electrostatic field between the head and the work and that atomization of the paint occurs at the point of greatest concentration of the electrostatic forces in that field. The plaintiff undertook to support the contention on the basis of an experiment conducted while the head was grounded. It is said that the grounding of the head eliminated the electrostatic field between the head and the work, leaving unaffected the electrostatic field between the electrode and the work. The contention, however, is entirely spurious. The head was neutral when insulated or non-conductive and uncharged. Grounding it made it a positive electrode of the same polarity as the work and with

the same positive attraction for the particles of paint as the work. The inability of the system to deliver paint effectively with the head thus grounded and made a positive electrode is not surprising, but it lends no support whatever to the plaintiff's contention.

It is clear that the only active discharging electrode is the separate electrode connected to one side of the power source. It is the sole source of the negative ions effectively charging the particles of paint and moving them toward the work. While the head is the recipient of such ions by bombardment from the electrode just as the particles of paint are, it supplies none of itself.

If then the field be viewed as the one field existing between the two active electrodes, there is no separate field between the head and the work, and atomization of the paint does not occur at the point of greatest concentration of the electrostatic forces, which is at the discharging electrode.

Regardless of the answers to all of these questions arising out of an interpretation of the language of the injunction, consideration must be given to the prior art for it was never intended, of course, that the injunction should prohibit its practice.

In one of the plaintiff's expired, prior art patents in the No. 1 process,[9] it is recited that sometimes the spray gun itself is charged and made the active electrode. Even if the spray gun was uncharged, that and other Ransburg patents[10] show that the ungrounded head was sometimes in the electrostatic field, and when it was there it received a floating static charge precisely as do the heads of Ionic's devices. The system of this prior art was thought not to invalidate Ransburg's patents on the No. 2 system for, even

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[9] Pugh Patent No. 1,855,869 (1928).

[10] Ransburg Patent No. 2,334,648 (1939); Helmuth Patent No. 2,421,787 (1945); Ransburg Patent No. 2,509,277 (1945).

though the spray gun was directly connected to the power source or received a static, floating charge from the active electrode, atomization of the paint was essentially mechanical and not electrostatic. Nevertheless, it seems perfectly plain that electrostatic forces were present and operating to at least an equal extent and to an equal degree as they are present and operating in Ionic's devices. Ionic is entitled to practice that prior art system, and if the electrostatic forces play any part in its atomization of the paint, it differs neither in kind nor in degree from the part played by those same forces in the prior art systems.

We then come to the conclusion that infringement of Ransburg's patents on the No. 2 system is not avoided by partial dependence upon some other means to achieve atomization of the paint as long as there is substantial dependence upon electrostatic forces within the teaching of the patents, as the District Court initially held and we approved. There is no infringement, however, when dependence upon the electrostatic forces to atomize the paint is so insubstantial and minimal that it does not exceed the employment of those same forces in the prior art systems.

It follows that Ransburg did not sustain the heavy burden placed upon it[11] of showing that Ionic was in contempt of the court and in violation of its decree by producing and marketing the presently accused devices.

Subsequent to the hearing of this appeal, a motion was made before a panel consisting of Judge Sobeloff, Judge Bryan and the writer that the case be remanded in general to the District Court for reopening and consideration of a Russian patent and articles which were said to have come to light only recently and which Ionic contends completely anticipate and invalidate the Ransburg patents on its No. 2 system. In light of our disposition of the appeal, this

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[11] General Electric Co. v. Wabash Appliance Corp., E. D. N. Y., 29 F. Supp. 1003.

motion may be academic, but the remand will be with leave to the District Court to consider any such application that may be made to it and to reopen its prior judgment, notwithstanding our previous affirmance of it, and to enter any modifying or substitute order which may seem appropriate.

I am authorized by Judges Sobeloff and Bryan to express their approval of this disposition of the motion.

*Reversed and remanded.*

UNITED STATES COURT OF APPEALS
FOR THE FOURTH CIRCUIT

**No. 10,347**

**RANSBURG ELECTRO-COATING CORP.,**

*Appellee,*

**vs.**

**IONIC ELECTROSTATIC CORPORATION,**

*Appellant.*

Appeal from the United States District Court for the District of Maryland.

This cause came on to be heard on the record from the United States District Court for the District of Maryland, and was argued by counsel.

On consideration whereof, It is now here ordered, adjudged and decreed by this Court that the decree of the said District Court appealed from, in this case, be, and the same is hereby, reversed with costs; and that this cause be, and the same is hereby, remanded to the United States District Court for the District of Maryland, at Baltimore, for further proceedings not inconsistent with the opinion of the Court filed herein.

CLEMENT L. HAYNSWORTH, JR.
Chief Judge, Fourth Circuit.

UNITED STATES COURT OF APPEALS

FOR THE FOURTH CIRCUIT

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|---|---|
| RANSBURG ELECTRO-COATING CORP., *Appellee,* vs. IONIC ELECTROSTATIC CORPORATION, *Appellant.* | No. 10,347 |

**APPEAL FROM THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF MARYLAND, AT BALTIMORE.**

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The Court having heretofore on April 11, 1968 entered its judgment and filed an opinion in the above entitled case and a petition for rehearing having been filed on May 9, 1968,

Now, therefore, upon consideration of the petition for rehearing,

It is ordered that the petition for rehearing be, and the same is hereby, denied.

CLEMENT F. HAYNSWORTH, JR.
Chief Judge, Fourth Circuit

HERBERT S. BOREMAN
United States Circuit Judge

UNITED STATES COURT OF APPEALS

FOR THE FOURTH CIRCUIT

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|---|---|
| RANSBURG ELECTRO-COATING CORP., *Appellee,* vs. IONIC ELECTROSTATIC CORPORATION, *Appellant.* | No. 10,347 |

**APPEAL FROM THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF MARYLAND, AT BALTIMORE.**

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Upon consideration of the motion for leave to move the District Court for an order granting a new trial and of the memoranda in support and opposition,

It is ordered that the motion for leave to move the District Court for a new trial be, and is hereby denied.

CLEMENT F. HAYNSWORTH, JR.
Chief Judge, Fourth Circuit

s/ HERBERT S. BOREMAN
United States Circuit Judge

A True Copy, Teste:
SAMUEL W. PHILLIPS, Clerk

By MARGARET P. ATKINS
Deputy Clerk

**RANSBURG ELECTRO-COATING CORPORATION**
**v.**
**PROCTOR ELECTRIC COMPANY, INC.**
**and**
**IONIC ELECTROSTATIC CORPORATION.**
**Civ. A. No. 10181.**

United States District Court
D. Maryland.
May 19, 1965.

R. DORSEY WATKINS, District Judge.

Plaintiff has filed a petition to have defendant Ionic Electrostatic Corporation (hereinafter "defendant"; Proctor is not herein involved) adjudicated to be in contempt of an order passed by this court on May 7, 1962, and for an awarding of damages, including actual damages, expenses and attorney's fees, for such alleged contempt. Subsequently the petition was amended to request trebling of actual damages for alleged willful and wanton violation of the injunction. Defendant has responded, denying any violation of the injunction and claiming that all its conduct was in good faith, and at least part thereof taken upon advice of counsel.

Six days were spent in the hearing of testimony, and numerous exhibits were filed. Thereafter time was allowed for the filing of briefs, followed by a full day of oral argument.

**Background.**

On March 15, 1962 this court rendered its opinion in Ransburg Electro-Coating Corporation v. Proctor Electric Company, Inc. and Ionic Electrostatic Corporation, D.Md. 1962, 203 F.Supp. 235, affirmed 4 Cir. 1963, 317 F.2d 302,

upholding the validity of the five patents of plaintiff in suit, and finding infringement by defendants of certain designated claims thereof. While a full understanding of the issues presently involved would certainly, if not requiring, be aided by, a reading and study of that opinion, it may suffice to say that the patents in question related to electrostatic spray-coating systems.[1] Early in the opinion the court referred to plaintiff's contentions, which it upheld, that the patents in suit disclosed methods and apparatus in which "the paint is made the electrode and electrostatically atomized, or that at least the paint is charged and atomized at the point of highest field intensity, is at the moment of atomization given a 'built-in' charge, and that the electrostatic field thereupon disperses the particles, and deposits them upon the work."[2] With respect to the scope of the patents, and infringement, defendants contended, but the court found to the contrary, that "the patents, if valid, are limited to those applications in which electrostatic forces are the *sole* source of atomization, dispersion and deposition. Otherwise stated, defendants claim that no infringement occurs if, specifically, centrifugal force plays *any* part, no matter how small, in either and/or atomization, dispersion or deposition."[3]

In connection with defendants' contention of file wrapper estoppel the court said:[4]

> "The court is of the opinion that the minimum clearly allowable to plaintiffs as the result of the Patent Office prosecution is that plaintiff's patents cover any case in which the paint, as presented to the field (by gravity,

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[1] Not limited to or even requiring, an electrostatic atomization of paint, as defendant herein urges; although such electrostatic atomization was in fact found to be present in the actual processes practiced by plaintiff, and in the accused devices.

[2] 203 F.Supp. at page 238.

[3] 203 F. Supp. at page 239. Italics in the original text.

[4] 203 F.Supp. at page 251; see also page 253, last full paragraph.

or centrifugal force) is then atomized under circumstances in which electrostatic forces either predominate, or form a significant factor."

[1] In its opinion, the court requested counsel to submit an appropriate decree. Drafts were presented by both sides. In addition to the normal differences in language of two persons expressing the same general idea, there was a material difference in the substantive approach to the drafting of the injunctive provisions. Plaintiff in effect sought to embody by reference the patents in suit, and the court's opinion with respect thereto. Defendants insisted that under F.R.Civ.P. 65(d), the injunctive portion of the decree must "describe in reasonable detail, and not by reference to the complaint or other document, the act or acts sought to be restrained * * *". With this the court ultimately agreed.

Further difficulty was experienced in framing the language of the injunctive paragraph, in that all the devices currently used by plaintiff's licensees under the patents, and all the accused devices, used metal atomizing "heads" which were directly charged. Defendants sought to have the "process" portions of the injunction limited (among other things) to any process in which an electrical potential is created at the edge of the atomizing head by applying voltage "directly" to said atomizing head. The court refused to embody this limitation.[5]

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[5] Hearing of May 4, 1962, page 12. While reference to the head as being "charged" might be subject to improvement, neither side had any difficulty in understanding that in eliminating the word "directly" from the reference to the electrical potential created at the edge of the atomizing head, the court was including any method by which this could be effected—directly to metallic head through a conducting shaft; by roller contact to an insulated head; by induction, or by prayer [ante-dating the School Prayer cases, but not in conflict therewith, since no governmental agency, Federal, state or municipal, is directly or indirectly involved].

The resultant paragraph 19 of the decree reads as follows:

"19. Defendant, Ionic, including its officers, agents, servants, employees and attorneys, and those persons in active concert or participation with them, and each of them, is enjoined from:

"(a) Making, using or selling the apparatus described, respectively, in this cause as 'Model 12,' 'Model 50' and 'Model M-50,' or equivalents thereof, during the life of any of United States Letters Patent No. 2,685,536, No. 2,794,417, No. 2,893,893 and No. 2,893,894, and making, using or selling the apparatus described, respectively, in this cause as 'Model 50' and 'Model M-50,' or equivalents thereof, during the life of United States Letters Patent No. Re. 24,602.

"(b) Practicing the electrostatic spray coating process which is performed in the use of the apparatus described, respectively, in this cause as 'Model 12,' 'Model 50,' and 'Model M-50' or equivalents, including any process, (1) in which liquid coating material is advanced in a thin film to the edge of an atomizing head, an electrical potential is created at said edge by applying voltage to said atomizing head, said electrical potential being sufficient to create an electrostatic field between said atomizing head and the objects to be coated of sufficient strength to atomize, disperse and deposit the liquid coating material on the articles to be coated; or, (2) any process in which liquid coating material is advanced in a thin film to the edge of an atomizing head, an electrical potential is created at said edge by applying voltage to said atomizing head, said electrical potential being sufficient to create an electrostatic field between said atomizing head and the objects to be coated of sufficient strength to disperse and deposit the liquid coating material on articles to be coated and atomizing liquid coating material at the point of highest concentration of the lines of force in the electrostatic field, during the life of any United

States Letters Patent No. 2,685,536, No. 2,794,417, No. 2,893,893 and No. 2,893,894.

"(c) Actively inducing others to perform, or contributing to the performance by others of, any of the acts enjoined in subparagraphs (a) and (b) immediately above."[6]

The decree of the court, including the injunctive provisions of paragraph 19, was appealed and was affirmed in Ransburg Electro-Coating Corp. v. Proctor Electric Company, Inc. and Ionic Electrostatic Corporation, 4 Cir. 1963, 317 F.2d 302.

Defendant, while admitting that the provisions of the decree are binding, and that the question of validity, both of the patents in suit and of the injunctive provisions of the decree therein, may not be raised by collateral attack, does in substance question the propriety of the injunctive provisions, and, on the matter of damages, seeks to show that the accused devices, if construed as contravening the court's decree, would fall within the prior art.[7]

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[6] Paragraph (a) is not involved, except as the devices in question are "equivalents" of those of plaintiff. The emphasis herein has rather been upon the infringement of the process portions of paragraph (b), defendant conceding that the contributory infringement provisions of (c) would make it liable, if the accused processes fall within paragraph (b).

[7] Defendant has been as versatile in its shifting of counsel as it has been in its proliferation of processes. Original counsel were dropped for the appeal. Appeal counsel appeared in the first phases of the contempt proceedings but thereafter withdrew, whether voluntarily or by request is not known and in any event is immaterial. Their tenure was not of sufficient length or character for the court to have adequate opportunity to appraise them. The court does have great respect for original trial and present counsel for defendant, and for plaintiff's counsel, who have continued without change throughout all stages.

**The Accused Processes.**

In considering the processes employed by the accused devices, particular importance must be paid to at least two aspects of the language of Paragraph 19(b) of the decree. First, the process thereby enjoined is an "electrostatic spray coating process", not simply an electrostatic atomizing process. Secondly,[8] while (b)(1) relates to a process in which the electrical potential created at the atomizing head is sufficient to create an electrostatic field between the atomizing head and the objects to be coated of sufficient strength to "atomize, disperse and deposit" the liquid coating material, (b)(2) requires the field only to be of sufficient strength to disperse and deposit the liquid coating material, and that the liquid coating material be atomized [by any means] at the point of highest concentration of the lines of force in the electrostatic field.

The accused processes are practiced through the use of Ionic Model 10 hand gun, Ionic Model 25 and Ionic Model 30. Although a word description is necessary, diagrams of these three devices were introduced into evidence as Plaintiff's Exhibits 9, 7 and 8 respectively, and are attached as Appendix A. On the diagrams, the metal portions of the models are indicated by heavy oblique lines.[9]

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[8] While the difference will be obvious to one who has closely followed the primary case, the gilding of the lily may be excused as to others, who may think of the lily primarily as a more expensive and less edible variety of the onion family.

[9] On the diagram (Plaintiff's Exhibit 9) forming part of Appendix A, the head of the Model 10 is shown as metal. The current Model 10 is apparently furnished with a plastic head, although this is interchangeable with metal heads.

The Model 25 has a metal head.

The Model 30 has a plastic head.

The functional descriptive notations on the diagrams of the Models 25 and 30; e. g. "high voltage grid for charging mechanically pre-atomized * * * materials to facilitate electrostatic deposition", "point of highest field intensity" and "no contact with

In each of the devices the head is mounted on the metal shaft of a metal air motor which, with the head, is insulated from ground.[10] Either the metal motor, or some other metal element of each device is connected to the high-voltage source ("power pack"). In some instances this connection is established through an electrical resistance provided for safety purposes.

**Model 10.**

This device is intended to be held in the hands of an operator during use. It has a tubular handle of insulating material, about two inches in diameter and three feet in length, at one end of which the atomizer is mounted. In some devices, the handle is straight, while in others it is bent adjacent the atomizer.

The handle completely houses the air motor, but the rotating head, which has a diameter of about 1⅞ inches, projects from the end of the handle. The paint to be sprayed, and the air for operating the motor are supplied by passages extending through the long handle. A high voltage lead from the power pack also extends through the handle and has its front end connected to the metal motor body through an electrical resistance.

In at least some early Model 10 devices, the cup-like head[11] was of metal and was directly connected to the high-voltage source through the motor shaft and the lead contained within the handle. The head was thus directly charged, and defendant does not seriously contend that this is not the equivalent of its old Model 12, and an

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atomizer or paint supply" are defendant's self-serving characterizations and are not to be considered as factual.

[10] The importance of this feature is later discussed.

[11] None of the accused devices has a flat disc head, such as was discussed in the principal case.

infringement; and to the extent, if any,[12] to which sold after the decree, a contempt.

According to the Ionic instructional manual, the power pack supplied with the Model 10 has three output terminals respectively providing voltages of 15,100, 20,100, and 27,600.

**Model 25.**

This model is adapted to be mounted on a stationary support for use in painting articles carried past it by a conveyor. The metal air motor, which is not enclosed, is mounted on the end of an elongated insulator, and the cup-like head is mounted in the forwardly projecting end of the motor-shaft. Behind the motor, the long insulator bears a forwardly flaring conical member of insulating material the rim of which is about five inches in diameter and laced with a fine wire, which is connected to the high-voltage source. The Model 25 is regularly sold with a metal head about 1¾ inches in diameter.

Defendant in its literature suggests that the head of the Model 25 may be spaced four inches from the work and that in most instances the potential applied to the wire lacing be 90,000 volts.

In defendant's Bulletin 100 relating to the Model 25[13] it

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[12] During the course of the contempt hearings, defendant's counsel undertook to supply the date upon which it was contended that sale of the Model 10 with a metal head was discontinued. This was not done.

There has been no testimony as to any effort by defendant to recall any of the metal-headed Model 10's sold before the decree, or to endeavor to require purchasers before the passage of the decree thereafter to remove the metal heads. For the reasons hereafter to be stated, the court does not mean to imply that substitution of plastic for metal heads would avoid infringement and/or contempt.

[13] Plaintiff's Exhibit 50, page 5. Although it is stated that this is for "precipitation" only, it is the required operational voltage for the system.

is stated that the required operational voltage "may be *induced* merely by an indirectly coupled electrostatic concentrator [presumably the wire lacing], or may be applied directly to the head of the atomizer." [Emphasis supplied].

**Model 30.**

This device, like the Model 25, is intended to be mounted on a stationary support for use in coating articles conveyed past it. Further like the Model 25, its exposed metal air motor is mounted on an insulator. The Model 30 differs from the Model 25 in that the wire lacing is replaced with a head-surrounding, sharp-edged metal ring 14 inches in diameter located about 2¾ inches rearwardly of the head-rim and connected to the power pack. The head is of plastic and about three inches in diameter.

For the Model 30, defendant suggests that the spacing between head and work may be two inches and that in most instances the voltage applied to the ring oe 90,000 volts.

**Discussion.**

Plaintiff contends that all three of defendant's devices are, and employ processes that are, infringing. Defendant (except as to the Model 10 with a metal head) contends that none of the devices is, or employs a process which is, infringing, and that therefore there is no contempt. The impact of the provisions of Paragraphs 19(b) (1) and 19(b) (2) will have to be considered separately.

Paragraph 19(b) (1) of the decree— Field sufficient to atomize, disperse and deposit.

Defendant seems to deny (1) the existence of a field between the head of the devices and the article to be painted; and (2) if there be such a field, that it is sufficient

(a) to atomize the liquid coating material, or (b) to disperse it; and seems to aver (3) that deposition is not a true function of the potential existing at the various heads.

With respect to the application of the provisions of section (b) (1) of Paragraph 19 of the decree, the testimony ranged from the highly theoretical to the pragmatically practical.

On the theoretical side, defendant relied largely upon the testimony of its expert, Dr. Seville Chapman.[14] He had made extensive study of the "geometry" of fields, and had prepared two- and three-dimensional analogs of the "fields" associated with the accused devices, using metal heads[15] on all three. His starting point was that really there existed a universal field, and that this field was distorted by the introduction of "anything" into it; the distortion being greater in the case of the introduction of a man-made electrical "field"[16] within it.

As to the Model 25 and the Model 30, and conceding that for the purposes of the case it was satisfactory to speak of a "field" with respect thereto, he testified that the "field" was between the electrodes on those devices and the work; and that there was really no field between the atomizing heads and the work; although he recognized that in the case of metal heads they were charged simultaneously

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[14] Dr. Chapman impressed the court far more favorably than did defendant's experts in the main case, both as to competence and fairness. He frankly admitted, however, that he had had no practical experience, or even acquaintance, with commercial electrostatic spray coating. His highly involved, and theoretical, approach will become apparent in the course of this opinion.

[15] He explained that it was impractical to use plastic heads in these studies. If the results be accepted as establishing the conclusions he sought to draw, his comment that (except in one instance) they would have been even less favorable to plaintiff if plastic heads could have been used, appears reasonable.

[16] Or "sub field" (?) or "sub-sub field" (?), etc.

with the throwing of the switch creating the field between the electrodes and the work; and that with respect to plastic heads, they came to their field potential also simultaneously. In this concept, there were infinite lines of descending gradients between the electrodes (the highest potential, or 100) and the work (0); the atomizing heads, as any other intrusion into this field, being subjected to the gradient associated with its position between the electrodes and the work.

Dr. Chapman also recognized that in the ordinary (and practically, necessary) concept of the man-created field associated with electrostatic coating of materials, the "field" was created by all the elements present; a change in any, would affect the geometry of the field. Although there was one field "all over the place", one could focus on any particular part, and for convenience, or by way of shorthand, reference could be made to the "field" between the head and the work.[17] In this context, between the head and the work, the field at the head was at the highest intensity of anywhere in that area, location or dimension.[18]

Defendant's devices are designed to be, and in fact are, operated at high rotational speeds, in the order of 21,000 revolutions per minute. With the application of current to the metal head of the Model 10, or indirectly to the plastic head of a Model 10, the metal head of the Model 25, and the plastic head of the Model 30, at least five forces were operative, acting upon paint presented to the edge of any of the revolving heads. Of these, surface tension tended to maintain the integrity of the paint, and to keep it from disintegrating ("atomizing"), dispersing and depositing. Opposed to this were electrostatic, centrifugal,

[17] Transcript, page 1155.
[18] Transcript, page 1153.

aerodynamic and gravitational forces. The paint therefore could not be broken into droplets until one or more of these opposing forces was sufficient to overcome surface tension. Of these opposing forces, the electrostatic force would tend to draw the paint into droplets, and to break them off from the body of the paint. As the electrostatic field is created between the head and the "work", the general tendency would be for the droplets so created to be directed toward the work; moreover, such atomizing force would impart an electrical charge to the droplet which would direct it toward the work (dispersion and deposition). Such force, whatever it be, would not be eliminated by the other existing forces.[19] Centrifugal forces would tend toward radial distribution of the formed drops, and the aerodynamic or "drag" forces would tend toward tangential dispersion. Gravity would be manifested in its ordinary connotation of attraction toward the center mass of the earth.

The asserted relationship of these forces was set forth in an exhibit prepared by Dr. Chapman, reproduced here as Appendix B, which was the subject of substantial direct and cross-examination and rebuttal testimony. Dr. Chapman at first took the position that these disruptive forces were "additive",[20] and specifically that this was true of the centrifugal and aerodynamic forces.[21] This was changed promptly to the statement that their relationship was that of "vectors", not arithmetical.[22] He was insistent that electrostatic forces could not be responsible for a "primary" drop[23] smaller than 25 mils.

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[19] Transcript, page 1153.
[20] Transcript, page 1069.
[21] Transcript, page 1128.
[22] Transcript, page 1129.
[23] Although Dr. Chapman frequently referred to the "primary" drop formed by electrostatic atomization, through the pinching off

With the greatest respect for the testimony of defendant's expert, the court cannot accept it, particularly as to his denial of the significance of the electrostatic forces.

1. Plaintiff's expert pointed out with irrefutable logic that

(a) As surface tension was the only force maintaining the integrity of the paint at the head of the atomizing device, *any* force exceeding surface tension would be sufficient to overcome surface tension; therefore there could be no cumulation.

(b) Electrostatic forces in fact produced droplets finer than 25 mils.

(c) Since neither aerodynamic or centrifugal forces alone would be able to overcome the surface tension associated with the formation of drops of $\frac{5}{10}$ mils (Appendix B) none should be formed, but Dr. Chapman testified that with the aerodynamic and centrifugal forces available, something under ten per cent of the drops produced would be as large as 4 mils.[24] The physical demonstrations showed the falsity of this assumption.

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of the "Mae West" waist, followed by "secondary" droplets, he never amplified this. The inference that the court obtained was that a number or series of such secondary drops could be formed, and that they were smaller than the primary drops. If the primary drops were electrostatically formed, and if the secondary drops were the sequelae, they likewise would appear necessarily also to be electrostatically formed. Whether they would likewise carry a "built-in" charge was nowhere directly discussed by parties or witnesses; although the fair implication is that, as plaintiff contended, that as all atomization was electrostatic in nature, or that at least electrostatic forces played a significant part, these succeeding (or secondary) particles would likewise carry built-in charges.

[24] Transcript, page 1134.

2. Dr. Chapman admitted that his exhibit (Appendix B) had a margin of error of ½ pi-2-pi.[25]

3. The physical exhibits ("zip strips") clearly demonstrated the difference in size of drops, at high rotational speeds, with the field off and with the field on, the drops being smaller in the latter case.

4. Plaintiff's exhibits adequately established that the fields variously present between the heads of the painting devices and the work were adequate electrostatically to atomize paint at 0 revolution per minute. As rotation does not eliminate the electrostatic forces, and as surface tension was the only force maintaining the integrity of the paint, the electrostatic force of itself would continue adequate for atomization at least in the range down to below 10 mils and below that point would assist in "softening up" the paint to be, or where acted upon by, another force or forces. In any case the electrostatic forces either were of sufficient strength to atomize, or predominated, or formed a significant factor in the process.

The court therefore finds that on the preponderance of the evidence, the electrical potential at the edge of the atomizing head is sufficient to create an electrostatic field between the atomizing head and the objects to be coated of sufficient strength to atomize the paint. As the court also finds in the following section that the electrical potential is sufficient to create an electrostatic field between the atom-

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[25] A 400 percent (1.57 to 6.28) margin of error; many times that permitted of District Judges.

It would perhaps not be amiss here to dispose of the battle of similes. Dr. Chapman asserted that the atomization significance of the electrostatic field at 21,000 r.p.m. was equivalent to the squashing effect of the feather in the cap of an elephant when it stepped on a hen egg. Plaintiff responded with the story of the physicist who "conclusively" proved that the anatomy of the bumble bee would not permit it to fly.

izing head and the work of sufficient strength to disperse and deposit the paint, a fortiori these provisions of Paragraph 19(b) (1) of the decree are met.

Paragraph 19(b) (2) of the decree—Field sufficient to disperse and deposit; atomization occurring at the point of highest concentration of the lines of force in the electrostatic field.

These factors may conveniently be considered in reverse order:

(1) "atomizing liquid coating material at the point of highest concentration of the lines of force in the electrostatic field * * *." There is no dispute but that atomization, however produced, occurs at (or immediately adjacent to)[26] the edge or rim of the head. Also, there is no dispute that the highest concentration of lines of force, between the head and the work, is at the head. The dispute as argued by the parties, is as to whether there is a "field" between the head and the work, or whether the "field" to which reference is made in the above quotation is the field between the electrode and the work. The court is clearly of the opinion, and finds, that within the language of Paragraph 19(b) (2) of the injunctive decree, there is a "field" between the atomizing head and the work, and that the highest concentration of lines of force within this field is at the atomizing head, where atomization occurs.

A number of considerations lead to this finding:

1. The main argument made by defendant is that the field must exist between (a) the forward edge of the motor, in the Model 10 with a plastic head; (b) the wire lacing of the Model 25; (c) the metal ring of the Model 30—and the

[26] Under any theory, the drops are formed as the paint leaves the head.

work. This has in part been dealt with in connection with section (b) (1) of Paragraph 19 of the decree, where it was pointed out that for convenience or by way of shorthand, one could refer to the "field" between the head and the work. This seems almost inevitable, because, on the "universal field" approach, there would be no "field" between any electrode and any work, but only a distortion of the universal field. So the electrode, the line transformer, the power house generator, the earth, moon, sun and stars are significant only as distortions in or of this universal field.

The fact that metal atomizing heads are charged and plastic heads come to their field potential, simultaneously with the energizing of the electrode (as established by all the evidence, and as manifested by the necessity that the head be insulated from ground—see footnote 10 and text), and that the paint contacts the heads and not the electrodes, certainly justifies considering the gradient potential between the head and the work as *a* field.

Moreover, the context in which the word "field" is used in section (b) (2) of Paragraph 19 of the decree practically requires this construction. That section refers to an electrical potential applied to the edge of an atomizing head, said electrical potential being sufficient to create "an electrostatic field" between the head and the work of sufficient strength to disperse and deposit liquid coating material, and "atomizing liquid coating material at the point of highest concentration of the lines of force in *the* electrostatic field * * *" (Emphasis supplied). *"The* electrostatic field" is clearly the only electrostatic field previously mentioned —the one between the head and the work.

2. As mentioned above, defendant's Bulletin 100 relating to the Model 25, states that the required operational

voltage "may be induced merely by an indirectly coupled electrostatic concentrator, or may be applied directly to the head of the atomizer." Aside from an apparent concession of equivalence, which would be a direct violation of the injunction, this language[27] must mean that there is a field between the atomizing head and the work; otherwise, the Model 25 would be inoperative as would be the Model 10, particularly with the metal head.

3. While a concession, or even a direct assertion, by a party on another occasion cannot make true that which in fact is false, it is significant as to that party's understanding. When an assertion is made to secure the issuance of a patent, and denied when the party is being sued for infringement of another patent, perhaps the highest degree of significance is reached.

Defendant's president is the patentee of United States Patent 3,051,394 for "Electrostatic Spray Coating Apparatus and Method," issued on August 28, 1962, on a division of an application filed December 1, 1955.

The specification refers to a spray or atomizing gun surrounded by a discharge electrode.

> "Here, there is no direct contact between the discharge electrode and the head end of the spray gun, the head end being charged by induction."[28]
>
> • • • •
>
> "In this invention, a source of electrostatic high potential, having one terminal grounded and its opposite terminal surrounding the atomizing head, *creates a strong electrostatic field at the head by means of induction. The field extends between the head and the article to be coated*, the article being grounded. The force of this field transforms the atomized coating

[27] Significant also on the question of the measure of damages.
[28] Column 2, lines 59-62.

material into a spray of charged particles and creates an attraction which pulls the spray toward the grounded article."[29]

The specification further recites that the discharge electrode "may be adjusted forwardly and rearwardly relative to the head end of the gun in order to vary the degree of induction at the head end of the gun * * *"[30]

In United States Patent 3,001,890 to defendant's president, for "Electrostatic Deposition," issued September 26, 1931 on application filed July 27, 1956, in the more particularly described process the high voltage source is led to the head end of a spray gun and to an insulated rotating disc "so as to raise same to a sufficiently high potential to charge the liquid supplied thereto and discharged therefrom."[31]

"Also, if desired, the spray gun may be grounded and the high voltage may be applied directly to a grid ring or any shape of electrode which is disposed so as to charge the disc which is insulated. In this instance, the disc will also be at high potential due to the capacity effect between the grid ring or electrode and the disc itself."[32]

In another arrangement of electrical circuitry in which a high voltage source is connected to charge the nozzle and the disc, or at any time when the disc "*is charged either directly or indirectly*" and the work is grounded directly or indirectly, it is stated that "there is an electrostatic field between the atomizer and the object * * *"[33]

This leaves for consideration the question of whether

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[29] Column 3, lines 54-62; emphasis supplied.
[30] Column 6, lines 9-11.
[31] Column 3, lines 38-40.
[32] Column 3, line 74; column 4, line 4.
[33] Column 4, lines 12-16; emphasis supplied.

the field between the head and the work is sufficient (a) to disperse and (b) to deposit, the paint.

It is quite clear that if the formed particles acquire a charge at formation, or later acquire a charge in space, the charge is similar (positive or negative in each case), and as like charges tend to repel, the necessary effect is to cause a separation, or dispersal. In fact Dr. Chapman, in criticizing the testimony on behalf of plaintiff that when the field was on, the spot sizes deposited tended to be smaller than when the field was off (plaintiff plausibly contending that the particles were originally smaller in size because of electrostatic atomization, or because of the effect of electrostatic forces) explained that with the field on, the larger spots[34] tended to repel, rather than agglomerate with, the smaller spots.

The court has never had explained to it how paint particles, similarly, and so charged, that they were attracted to the work, can fail to exhibit both repulsion and dispersion. It is true that with regard to the work, the dispersion which would be effected by purely centrifugal or aerodynamic atomization would be far wider than that associated with electrostatic atomization. With purely centrifugal or aerodynamic atomization, the amount of paint deposited therefore would be nominal. But in electrostatic atomization, there is both the attraction of each particle toward the work, and a repulsion against coalescense, which represent the optimum attainable.

If the contention that the paint particles acquired their charge (presumably by ion bombardment) only after for-

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[34] Again indicating the unreliability of Appendix B, in that it represented at best a tendency, as distinguished from an accurate determination, or even a reliable forecast. See footnote 23, and associated text.

mation, were sound, elimination of the "field" between the head and the work, while preserving the "field" between electrode and work, should not reduce the efficiency of deposition; while elimination of the ion bombardment "field" between the electrode and the work, while maintaining the "field" (which would then uncontrovertably be a "field") between the head and the work, should materially reduce that efficiency. Actual tests[35] showed the contrary.

Eliminating the "field" between head and work by grounding the motor reduced the deposition efficiency by over 80 percent in the case of metal heads and by over 70 percent in the case of plastic heads. Eliminating the ion bombardment "field" did not lower deposition efficiency, but if anything slightly increased it.

These data, along with the specifications in United States Patents Nos. 3,051,394 and 3,001,890, supra, clearly establish, and the court finds, that in the accused devices, whether with metal or plastic heads, the potential thereto applied is sufficient to create an electrostatic field between the atomizing head and the work of sufficient strength to disperse and deposit the paint on the work, and that the paint is atomized at the point of highest concentration of the lines of force in the electrostatic field, and that the injunctive provisions of section (b) (2) of Paragraph 19 of the decree have been violated.[36]

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[35] Plaintiff's exhibit 44.

[36] Defendant was permitted to offer what it claimed to be prior art patents after an express disclaimer that there was any purpose to invalidate the patents in suit, but only to "limit the possible interpretation which may be given to the claims or the language of the injunction * * *" (Transcript, page 1319). Much of this prior art had been expressly considered in the main case and rejected as non-anticipatory, and the balance is no more pertinent. The finding that the accused devices and processes violate the injunction is the equivalent of a finding of infringement; and if they infringe, they cannot be following the non-anticipatory prior art, for "that which

By way perhaps of over caution, but as emphasis the court points out that defendant admits that Model 10 with a metal head is an infringement; and defendant's operational bulletin with respect to Model 25 establishes that it is a process equivalent to those of plaintiff held valid in the original case.

Judgment will accordingly be entered in favor of plaintiff on its motion for contempt of the court's decree herein.

**Damages.**

In the original case, the court found that a strong case had been made for the allowance of treble damages under 35 U.S.C. § 284, and reasonable attorney's fees under 35 U.S.C. § 285, and that the question was a close one, but in its discretion denied such allowance.[37] While, as indicated, the court in general is not inclined to award what are, in patent cases, in the nature of punitive damages, it feels that the facts in this case call, if indeed they do not cry, for such allowance.

The Model 10 with a metal head is an admitted infringement.

The starting point for the remaining accused devices is the court's admonition in the previous case that an appropriation of a patentee's idea is an infringement, even if the accused device is an impairment of the invention.[38]

In this case there has been a further studied effort to appropriate plaintiff's invention but to avoid literal infringement by a deliberate degradation. As frankly stated:

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infringes, if later, would anticipate, if earlier." (Marshall v. Procter & Gamble Mfg. Co., D.Md. 1962, 210 F.Supp. 619, 633, citing Peters v. Active Mfg. Co., 1889, 129 U.S. 530, 537, 9 S.Ct. 389, 392, 32 L.Ed. 738).

[37] 203 F.Supp. at pages 258-259.

[38] 203 F.Supp. at page 258; and cases cited.

"The head of the centrifugal atomizer is the most convenient and practical member to use as the charging electrode to create an electrostatic field for depositing paint because the field created begins and ends at the head and work respectively and is strongest for the amount of voltage applied and therefore most efficient. The head was thus charged in the Models 12, 50 and M-50 devices, but this unfortunately was held to constitute an infringement at the trial.

"To place the centrifugal atomizer head elsewhere with relation to the field presents a problem because it decreases the efficiency of the electrostatic system * * * "[39]

Moreover, defendant has deliberately sought to postpone the evil day of reckoning. Defendant's original trial counsel expressed a desire to have the new devices promptly presented to this court for determination as to infringement, vel non, and violation of the injunction. This was seriously impeded by defendant, which used a change of counsel, and then the withdrawal of discretion on the part of such counsel, particularly with respect to making the accused devices available, directly by purchase by plaintiff, or indirectly through examination at the premises of purchasers from defendant, as a delaying device, as an obstacle.

As to the contention that there was no field between the atomizing heads and the work, and that the charge, if any, on the heads, was insufficient not only for atomization, but for dispersion and/or deposition, patents Nos. 3,001,890 and 3,051,394 to defendant's president have previously been cited. While it is true that these do not establish the factual accuracy of the disclosures therein, they clearly establish that defendant could not have believed, at the time of the development of the accused devices, that they differed from plaintiff's devices as contended in the contempt pro-

[39] Defendant's brief, page 11.

ceedings—particularly as to any question as to the existence of a charge on the atomizing head; as to the existence of a field between the head and the work; and as to the contention that the atomized paint received its charge only between the head and the work.

Finally, defendant's contention that it relied upon the advice of counsel, instead of showing its good faith, is under the facts a further instance of double dealing.[40]

Here, defendant purportedly sought the advice of one counsel as to the Model 30 and another as to the Model 25.[41]

In connection with the rendition of such opinions, it was represented with respect to the Model 30 that "only the large remote grid ring was charged"[42] and that as to the Model 25 that the charge was "carried only to the sharp * * * to the sharp edged remote grid";[43] and in each case the attorney was told that the coating material was "mechanically" atomized or pre-atomized. It should also be noted that the opinion with respect to the Model 25 was obtained five days before the decree herein in which the court refused to limit the injunction to heads directly charged.

Moreover, the opinions were not sought as to the validity of devices (or processes) to be put upon the market, but only after they had been marketed.

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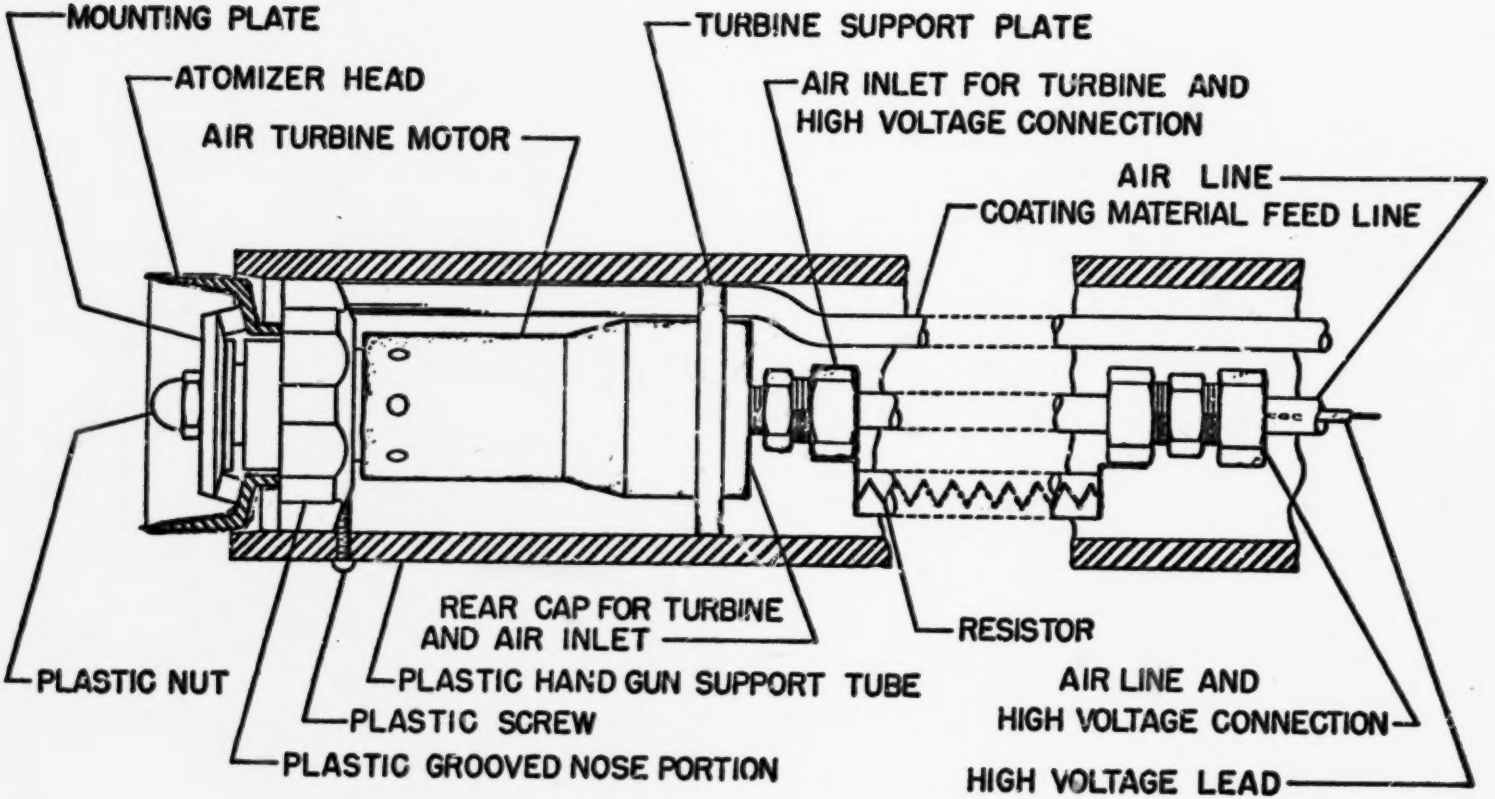
[40] The court does not mean to intimate that there is any impropriety in seeking, and relying upon, the advice of counsel, in an effort to be forehanded if any charge of wilful infringement is later made. But the court considers that there is a close analogy between the rules applicable to such cases, and those in which the advice of counsel is relied upon as a defense to an action for malicious prosecution. In the latter, there must be a full and frank disclosure to counsel of all facts that the client knows, or by reasonable diligence could discover; and the advice of counsel must have been sought with the intent of relying upon it.

[41] Defendant's exhibits 30, 31.

[42] Transcript, page 1311.

[43] Transcript, page 1313.

Plaintiff is accordingly entitled to (i) a judgment that defendant is in contempt of sections (b) (1) and (b) (2) of Paragraph 19 of the decree; (ii) damages for the infringement of plaintiff's patents, which damages will be trebled under 35 U.S.C. § 284; and (iii) reasonable attorney's fees under 35 U.S.C. § 285. The parties are directed to submit within ten days a decree satisfactory as to form, or if they are unable to do so, to submit proposed forms of decrees.



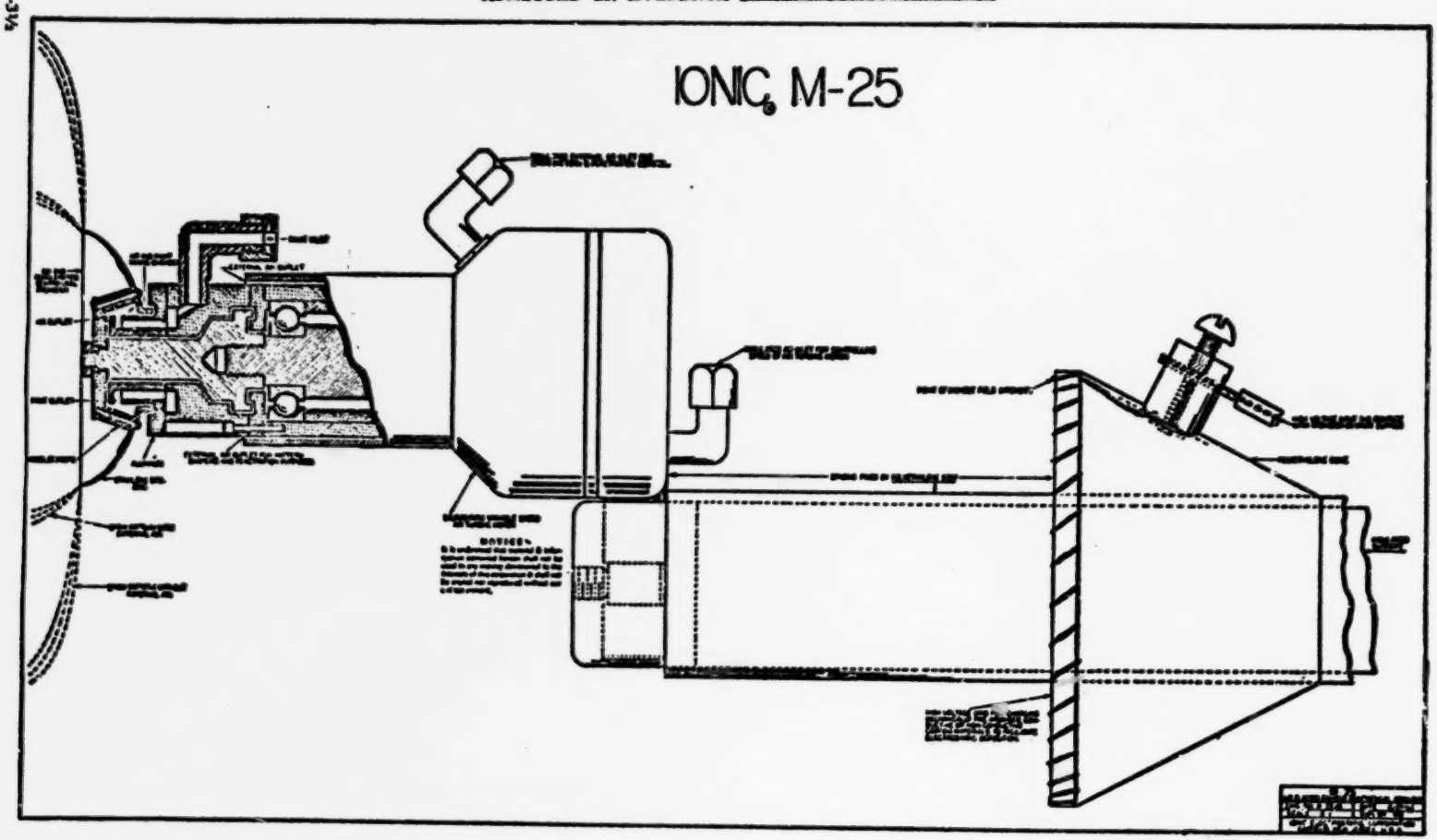

IONIC MODEL 10 HAND GUN

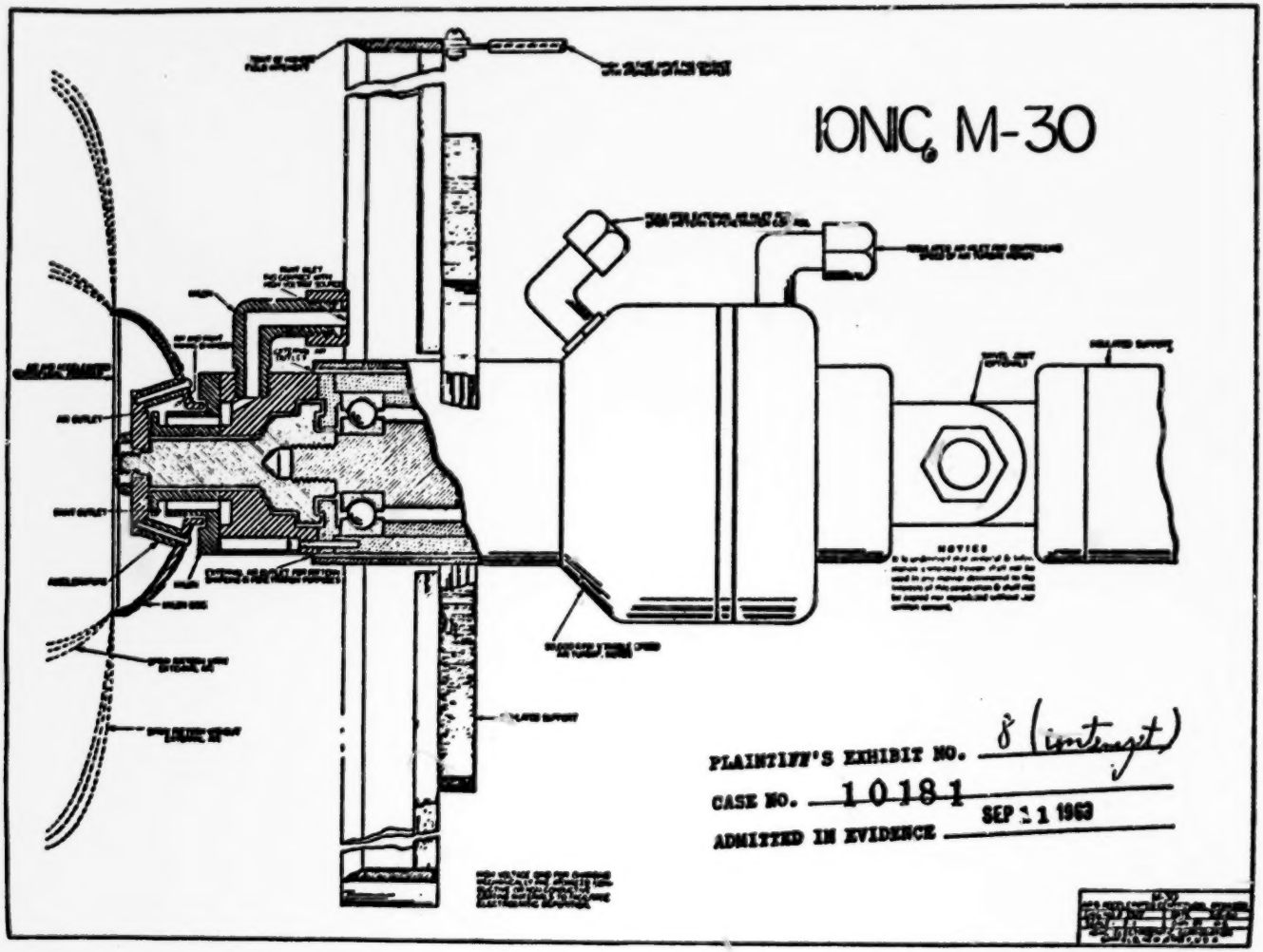
PLAINTIFF'S EXHIBIT NO. 9 (untested)
CASE NO. 10181
ADMITTED IN EVIDENCE SEP 11 1963

PLAINTIFF'S EXHIBIT NO. 7 (contempt)

CASE NO. 10181

ADMITTED IN EVIDENCE SEP 11 1963




IONIC, M-30
PLAINTIFF'S EXHIBIT NO. 8 (intervenor)
CASE NO. 10181
ADMITTED IN EVIDENCE SEP 21 1963

## APPENDIX B

## FORCES ON PAINT AT EDGE OF ROTATING DISC

The following formulas represent the forces acting on a droplet about the time it is "atomized". I give results in terms of *force per unit weight* (F/mg) for the droplet to facilitate comparison. I have arbitrarily called drops large, medium, medium small and small. I have arbitrarily chosen certain parameters as indicated.

$f$ = 350 revolutions/second = 21,000 revolutions/minute
$R$ = radius of disc = 4 cm $\cong$ 1.6 inch
$v = 2\pi f R$ = 8,800 cm/sec
$s$ = density of paint = 1 gram/cm$^3$ (approximate)
$D$ = density of air = 0.0012 gram/cm$^3$
$T$ = surface tension of paint = 25 dynes/cm (approximate)
$E_{max}$ = sparking field = 30,000 volts/cm (maximum)
$g$ = acceleration of gravity = 32 ft/sec$^2$ = 9.8 meters/sec$^2$
$r$ = radius of droplet
$C_D$ = drag coefficient $\cong$ 0.5 for big and medium droplets $\cong$ 1.0 for small
$e_o$ = permittivity of space = 8.854 x 10$^{-12}$ farad/meter

FORCE PER UNIT WEIGHT F/mg

| | | Large $r = 0.1$ cm = 80 mils dia. | Medium $r = 0.01$ cm = 8 mils dia. | Medium Small $r = 0.005$ cm = 4 mils dia. | Small $r = 0.001$ cm = .8 mils dia. |
|---|---|---|---|---|---|
| Surface Tension Force Required per unit weight | $\frac{3T}{2r^2 s g}$ | 3.8 | 380 | 1520 | 38,000 |
| Gravity | 1 | 1 | 1 | 1 | 1 |
| Electrostatic | $\frac{3 e_o (E_{max})^2}{2 r s g}$ | 12 | 120 | 240 | 1,200 |
| Aerodynamic | $\frac{3 C_D D v^2}{8 r s g}$ | 180 | 1,800 | 4,300 | 36,000 |
| Centrifugal | $v^2/Rg$ | 20,000 | 20,000 | 20,000 | 20,000 |

Seville Chapman Oct. 1, 1963

DEFENDANT'S CONTEMPT EXHIBIT NO. 24
CASE NO. 10181
ADMITTED IN EVIDENCE OCT 16 1963

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MARYLAND

| | |
|---|---|
| RANSBURG ELECTRO-COATING CORP., *Plaintiff,* vs. IONIC ELECTROSTATIC CORPORATION, *Defendant.* | CIVIL ACTION NO. 10181 |

## Contempt Decree

This cause came on to be heard on the petition of plaintiff Ransburg Electro-Coating Corp., filed September 28, 1962, to have this Court issue an order directed to defendant Ionic Electrostatic Corporation, that it appear and show cause why it should not be held in contempt of this Court, and that, failing such showing, defendant Ionic Electrostatic Corporation be punished for civil contempt for violating the injunction provisions of the judgment of this Court entered May 7, 1962, in favor of the plaintiff in this cause, and ordered to account for and pay damages to the plaintiff, together with the profits defendant derived from its acts committed in violation of said judgment, and with the expenses and costs, including attorneys' fees, incident to the bringing and prosecution of the contempt proceeding.

Upon consideration of the said petition and accompanying affidavit in support of the allegations thereof; upon consideration of the answer to plaintiff's petition filed October 18, 1962, by defendant Ionic Electrostatic Corporation, pursuant to this Court's order of September 28, 1962, that the defendant Ionic Electrostatic Corporation show cause within twenty days from that date why the plaintiff's petition should not be granted; upon consideration of the

motion filed September 11, 1963, by plaintiff to amend its petition for contempt order to include a prayer that the damages be increased to three times the amount assessed; upon preliminary hearings had on November 27, 1962, and June 25, 1963; upon the presentation of evidence by both plaintiff and defendant in eleven days of additional hearings, the filing of briefs and a full day of oral argument; and it appearing to the Court, and the Court having filed an opinion on May 19, 1965, finding, *inter alia,* (1) that said defendant Ionic Electrostatic Corporation is in contempt of this Court, in this cause, by having made, used, and sold devices identified as Ionic "Model 10", "Model 25", and "Model 30", by having actively induced others to use said devices and to practice the processes through the use of said devices, and by having contributed to said use of said devices and processes by others, all subsequent to, and in violation of, the injunction provisions of the judgment of this Court entered in this cause May 7, 1962; and (2) that the acts of said defendant constituting said contempt were in deliberate and wanton disregard of the rights of plaintiff, and were carried out in such bad faith that an award of increased damages and attorneys' fees is appropriate in this cause;

IT IS HEREBY ORDERED, ADJUDGED, AND DECREED:

1. That the said Ionic Electrostatic Corporation is in contempt of this Court, having acted in wanton violation of sections (b)(1), (b)(2) and (c) of Paragraph 19 of the permanent injunction set out in the decree of this Court entered herein on May 7, 1962, through its manufacture, use and sale of devices identified herein as Ionic "Model 10", "Model 25", and "Model 30" and by having actively induced others to use said devices and to practice the processes through the use of said devices, and by having con-

tributed to the said use of said devices and practices by others, subsequent to the date of the service of the said permanent injunction upon the said defendant herein.

2. That plaintiff recover from defendant Ionic Electrostatic Corporation damages for infringement of United States Letters Patents No. 2,685,536, No. 2,794,417, No. 2,893,893, and No. 2,893,894, pursuant to Title 35 U.S.C. Section 284, by reason of defendant Ionic Electrostatic Corporation making, using, and selling in the United States, since the date of service upon it of the aforesaid decree and injunction, one or more of the aforesaid "Model 10", "Model 25", and "Model 30" coating devices, and by having actively induced others to use said devices and to practice the processes through the use of said devices, and by having contributed to the said use of said devices and practices by others, which damages will be trebled under 35 U.S.C. section 284.

3. That the Court, having previously appointed on June 25, 1963, Samuel J. Fisher as a Special Master in this cause to ascertain and report to the Court the amount of damages adequate to compensate the plaintiff, together with interest thereon, for infringement of said patents found to exist by the judgment of May 7, 1962, hereby refers the contempt portion of this cause to said Special Master to take and state an account, separately, of the amount of damages adequate to compensate the plaintiff for said acts of infringement constituting said contempt, together with interest thereon.

4. That the amount of said damages for the acts of infringement constituting said contempt be increased to three times the amount so ascertained and reported to the Court by said Special Master, under 35 U.S.C. Section 284.

5. That the action of the Special Master in the contempt portion of this cause shall be deferred until after the time for appeal herefrom has expired, if no appeal is taken, or until the return of the mandate from the Court of Appeals, if an appeal herefrom should be taken.

6. That the plaintiff recover from defendant Ionic Electrostatic Corporation its costs, together with reasonable attorneys' fees, under 35 U.S.C. Section 285.

7. That the parties hereto having, at the direction of the Court, submitted proposed forms of decrees, said forms are hereby denied by the Court except to the extent incorporated herein, and the parties are hereby given exceptions to the extent that their proposed forms have not been incorporated herein by the Court.

/s/ R. Dorsey Watkins
United States District Judge.

June 22, 1965.

**RANSBURG ELECTRO-COATING CORPORATION,**
**a corporation, Plaintiff,**

**v.**

**PROCTOR ELECTRIC COMPANY, Inc.**
**a corporation, and**
**IONIC ELECTROSTATIC CORPORATION,**
**a corporation, Defendants.**

**Civ. A. No. 10181.**

United States District Court
D. Maryland.

March 15, 1962.

R. DORSEY WATKINS, District Judge.

This case involves claims by plaintiff for infringement of patents relating to electrostatic spray-coating systems, and counterclaims by defendants for declarations that said patents are invaiid, and are not infringed. The actual devices developed by plaintiff and defendants are used solely in the field of electrostatic painting, and except with respect to a discussion of the prior art, only that field need be considered.

**Background—Parties.**

Plaintiff Ransburg Electro-Coating Corporation (plaintiff, or Ransburg) is an Indiana corporation organized on January 1, 1948, with its principal office and place of business in Indianapolis, Indiana. It was preceded in business by a partnership of Harper J. Ransburg and his sons Harold, Gregg and Edwin. Plaintiff owns the patents in suit, relating to methods and apparatus for electrostatic spray painting.

Defendant Proctor Electric Company, Inc. (Proctor) is a Pennsylvania corporation with a regular place of business in Baltimore, Maryland. It is a purchaser and user of certain alleged infringing devices, its acts having occurred in the District of Maryland.

Defendant Ionic Electrostatic Corporation (Ionic) is a New Jersey corporation. It was organized in May 1957 by John Sedlacsik, Sr., and his son, John Sedlacsik, Jr., doing business in the manufacture and sale of various types of electrical equipment. Ionic markets airless electrostatic spray-coating equipment. It has no place of business within the District of Maryland, but voluntarily entered its appearance, answered the original complaint, and has conducted the defense for both defendants.

**Background—Painting.**

In addition to the use of the familiar paint brush, many articles have for a number of years been, and are being, satisfactorily painted by dipping, roller coating, flow coating, and spraying. We are concerned only with the problems associated with spray-coating.

For many years, painting has been done with compressed air spray guns. Paint is brought to a head or nozzle and subjected to compressed air which "atomizes"[1] the paint and projects or propels the atomized particles for deposition up the articles to be painted. A skilled operator can closely control the size of the particles, and produce an excellent finished product. However, some of the particles fall short of the mark; and as the air must escape, a substantial volume of paint is carried away as "overspray" from, and misses, the target. Moreover, where the article

[1] The word "atomize" is customarily used to describe the fragmented particles of paint created by the flow of air.

to be coated is not solid and flat, the method is still less efficient. Health and safety considerations require the use of spray-booths, exhaust systems, and often, paint-recovery apparatus.

Paint losses in the use of compressed air spray guns may amount to sixty per cent, more or less, of the paint sprayed.

The Ransburg partnership had developed, and since 1944 had been marketing,[2] a patented improvement on the old compressed-air spray-gun method. This process was and is generally referred to as the "No. 1 Process." A conventional compressed air spray gun was used, but after atomization the atomized particles were directed toward and exposed to an electrostatic field maintained between a fine wire electrode and the articles to be painted, which were maintained at ground potential. To the extent that such particles received an electrical charge, they would be "urged" by electrostatic forces toward deposition on the work. The system represented a decided improvement over the compressed air gun, and effected a saving of about fifty per cent of the paint previously lost. However, not all the particles "atomized" received a charge, or a sufficient charge, to guide them to the work; and in some instances the force imparted in atomization, or by the current of air, was sufficient to result in overspray. Equipment such as spray-booths, exhaust systems, and paint recovery apparatus were still necessary.

Thought was given to methods of controlling or eliminating the current of air. The impetus toward the methods and apparatus in suit was adventitious. An exhibit of the No. 1 System was being prepared, consisting of a platform

[2] The system was licensed to several hundred users. Many of the licenses are still in effect.

on which was mounted the electrostatic spray grid, the spray gun, a spray booth, and the high voltage supply to the grid. An employee of the Ransburg partnership was standing on the platform, ironically enough preparing to put the finishing touches on the booth with a conventional paint brush, when he noticed that the paint was leaving the bristles in a fine spray, and was being deposited on an opposed grounded metal surface. This was reported to the partnership, and an analysis disclosed that the painter was standing on a wooden platform, holding the brush near the charged grid, and the paint on the brush had been subjected to the field between the grid and the grounded metal. This suggested an airless atomization and deposition, and led to further work resulting in the patents in suit.[3]

**The Patents in Suit.**

In the original complaint, infringement of four patents was alleged. Thereafter, leave was granted to file a supplemental complaint charging defendants with infringement of two newly issued patents, and substituting a reissue patent for an originally issued one. Defendants counterclaimed for declarations of invalidity and noninfringement as to all these patents. Plaintiff withdrew charges of infringement of Patent No. 2,658,472, and stated for the record in open court that no suits on this patent would be brought, or threats of suit be made against the defendants or any claiming through or under them with respect to any apparatus then in use by either defendant. There is no evidence, or proffer with respect thereto, as to the validity vel non of

[3] Some of the drawings in the first two patents reflect the effort to reproduce this situation, substituting for the bristles, spaced apertures with means for replenishing the paint as used.

Patent No. 2,658,472, and no declaration with respect to validity will be entered in this case.[4]

The patents presently in suit, all owned by plaintiff, are:

| Patent No. | Patentee | Issued |
|---|---|---|
| 2,685,536 | W. A. Starkey and E. M. Ransburg | Aug. 3, 1954 |
| 2,794,417 | W. A. Starkey and E. M. Ransburg | June 4, 1957 |
| 2,893,893 | W. W. Crouse | July 7, 1959 |
| 2,893,894 | E. M. Ransburg | July 7, 1959 |
| Re.24,602 | C. C. Simmons (a reissue of original patent 2,808,343, issued Oct. 1, 1957). | Feb. 17, 1959 |

Of these, the following claims are:

| Patent No. | Claims Allegedly Infringed | Typical Claims |
|---|---|---|
| 2,685,536 | 1 – 11 | 4, 10 |
| 2,794,417 | 3 – 4 | 3, 4 |
| 2,893,893 | 1, 2, 3, 5, 6, 8 – 10 | 2, 9 |
| 2,893,894 | 1 – 8 | 1, 7 |
| Re.24,602 | 1, 6 – 10, 12, 13, 15 – 21 | 8, 13, 15, 20 |

For reading convenience, the "typical claims" are printed as Appendix A.

Plaintiff claims that the patents in suit disclose methods and apparatus in which for the first time, in an airless electrostatic field, the paint is made the electrode and electrostatically atomized, or that at least the paint is charged and atomized at the point of highest field intensity, is at

[4] The court is willing to incorporate in the decree a finding that plaintiff is estopped from asserting against defendants or their privies any claim that any device of defendants in existence at the conclusion of the trial infringes said patent.

the moment of atomization given a "built-in" charge, and that the electrostatic field thereupon disperses the particles, and deposits them upon the work.

The methods claimed by plaintiff have been highly successful commercially. Substantially one-hundred per cent of paint used is deposited upon the work. Over 500 licenses exist, from which plaintiff derives $2,000,000 to $3,000,000 annually in royalties.

Defendants have introduced the usual defenses of invalidity and noninfringement. As is to be expected of competent counsel (and not to be discounted because of lack of "novelty"), these have encompassed the aspects of anticipation, lack of novelty, misuse of patent monopoly, lack of adequate disclosure, indefiniteness and excessive breadth of claims and double patenting. As to the scope of the patents, if valid, and on the question of infringement, defendants raise the issue of file wrapper estoppel. With respect to scope of the patents, and infringement, defendants contend that the patents, if valid, are limited to those applications in which electrostatic forces are the *sole* source of atomization, dispersion and deposition. Otherwise stated, defendants claim that no infringement occurs if, specifically, centrifugal force plays *any* part, no matter how small, in either and/or atomization, dispersion or deposition. These contentions make it more than usually difficult to departmentalize the treatments of validity and infringement.

During the trial of the case, and at its conclusion, the court of record stated to counsel the principal problems the court believed to be involved, and an adequate opportunity was given counsel to brief these and any other questions, and thereafter some two days of oral argument were allowed. As a result, some narrowing of the issues resulted.

The defense of misuse of the patent monopoly was not formally abandoned, but was not pressed, and the court finds that there is no legally sufficient evidence to support this defense. The claim of anticipation by public use has been reduced from three alleged instances to one.[5]

All reliance by defendants on prior publications has been abandoned.

Of the prior art references as to anticipation and/or lack of novelty, cited by defendants in advance of trial, one of their alleged experts testified as to the supposed significance and effect of 35.[6] Only seven were seriously pressed in defendants' final brief and argument.

**General Description of Nature of Patents in Suit.**

Patent 2,685,536 (Starkey '536) represents the method aspects of the first development of the airless electrostatic painting, which in its entirety has frequently been described as the No. 2 Process. All claims are in suit, claims 4 and 10 having been selected by plaintiff as typical.

The method is based upon the alleged discovery that with an electrostatic field established between a grounded object to be painted, and unatomized paint, and if the field were

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[5] The court does not criticize defendants' counsel for initially raising these three alleged instances. In view of the complete failure of the evidence with respect to two of them, the court would have been highly, and vocally, critical, if they had further been pressed.

[6] It is, perhaps, only fair to state that in the prosecution of the five patents in suit the Patent Office cited, as to

| | |
|---|---|
| '536 Patent | 19 references |
| '417 Patent | 5 references |
| '893 Patent | 16 references |
| '894 Patent | 13 references |
| '602 Reissue Patent | 15 references |

of appropriate strength,[7] and the paint were presented in a sufficiently thin condition, the field would, without the aid of air blast, centrifugal, hydraulic or other mechanical force, atomize the paint into particles, electrically charge such particles simultaneously or coincidentally with their formation, disperse them and deposit them on the object to be coated, the deposition being in accordance with the lines of force established between the paint at the points of atomization and the work.

Starkey '536 discloses several specific forms for an atomizing head by which unatomized paint may be presented to the field. In each of the examples the head presents toward the article to be painted an extended straight edge to which the paint is fed at a controlled rate, and along which edge the paint is presented in the form of separated, supported droplets, the spacing of said droplets being determined by the mechanical structural features of the head.

In each of the examples or forms specifically illustrated, the head is stationary; and as no air blast, centrifugal or hydraulic forces are shown or suggested, the atomization therefrom must, if it occurs (and it does[8]) have been solely electrostatically effected. However, the claims of Starkey '536 are not in terms limited to an electrostatic painting method in which the atomizing head is stationary, or pre-

[7] Ordinarily of the nature of 90,000 volts, direct current.

[8] The court, at the request of counsel, spent more than three days out of the court room, examining physical demonstrations of all plaintiff's devices (or replicas thereof), of the accused devices, and of some of the alleged prior art. Reporters were present during the demonstrations, and a record was made of any statements, explanations and questions of counsel. In addition, in several instances after the completion of particular demonstrations, the court dictated into the record, in the presence of counsel, and with full opportunity to counsel to object at attempt to correct, a summary of the court's observations.

sents the paint to the electrostatic field only in a straight line; or where the electrostatic field is the sole agent affecting or contributing to atomization, dispersion and deposition; although in Claim 10 there must be "an electrostatic field of sufficient strength that it both electrostatically atomizes small particles of coating material from such exposed termini and electrostatically deposits them * * *"

The method claims in Starkey '536 do eliminate the use of a high-velocity air blast for atomizing and depositing paint particles. Starkey '536 also discloses the paint as the charging electrode; or at least the presenting of the paint for atomization at the point of highest field intensity, where it is effectively charged sufficiently to cause its dispersal and deposition by the existing electrostatic field and forces.

Starkey '417 discloses and claims apparatus aspects of Starkey '536. It resulted from a voluntary division of the application maturing into Starkey '536, and has the same disclosures and drawings as Starkey '536. Claims 3 and 4 are in suit. They are directed to heads in which droplets are formed, either completely separated, or bridging the spaces at their bases. The claims are not, in terms, limited to apparatus in which the head is stationary, or to any specific structural mechanical feature with reference to the places where atomization occurs; nor is the electrostatic field claimed as the sole source and cause of atomization, dispersion and deposition, although the electrostatic field must be "capable of" atomization, dispersion and deposition.

Crouse '893 resulted from the discovery that electrostatic atomization could be effected without the initial separation, by mechanical means, of the fed paint into discrete droplets. Again, the specific heads shown are stationary. In each, the liquid is fed through an arcuate, annular, or straight line slot or opening to form it into a film of uni-

form thickness when presented to the electrostatic field. In all except one illustration of arcuate structures, a plug is inserted.

When the paint is subjected to the electrostatic field, the field forms or deforms the edge of the film into a series of spaced projections or streamers, frequently referred to as "cusps," the charged ends of which are broken off by the field, dispersed as a spray and deposited on the work. The spacing of the points of atomization is uniformly effected by the field, without the need of structural separation. The spacing is a function of the quantity of paint presented to the field, and the strength of the field. Much closer spacing of the points of atomization is possible than through mechanical spacing of droplets, and hence a greater amount of painting can be done in the same time.

While in Crouse '893 paint is fed under pressure to a chamber, all the devices shown rely upon a gravity flow; except in one instance, all the devices shown are designed to be operated with the work immediately below them. In the single exception illustrated, the work is placed immediately above an inverted container or head.

In practice, the annular form of apparatus is preferred. The field strength is substantially identical at all locations, as distinguished from the concentration of field strength which occurs at the ends of a straight-edged head. One apparent disadvantage of the use of the circular head is that it tends to cause the deposit of paint in a doughnut[9] shaped pattern.

Claims 1-3, 5, 6 and 8-10 of Crouse '893 are asserted against all the accused structures, claims 2 and 9 being as-

[9] Mid-Western nomenclature, used throughout the trial of the case. My own Baltimore, Maryland heritage would refer to the shape as that of a cruller.

serted as typical. Although all illustrations show stationary heads, the claims are not in terms so limited; nor are they limited to cases in which the film presented to the electrostatic field is formed by passing it through an elongated slot. Again, while the asserted claims are not in terms limited to heads in which the electrostatic field is the sole atomizing agency, the claims do call for the maintenance between the film edge and the article to be painted of a field "of sufficient strength" to draw the film into cusps and electrostatically to atomize particles from the edge of the film or from the cusps, and disperse and deposit them.

Ransburg '894 states that it is an improvement upon Crouse '893. It sought to produce greater uniformity in the pattern of the spray, and to overcome the gravitational limitations of stationary heads, by "rotating the film-supporting atomizer about the film axis." The specific embodiment described relates to an annular film, but other forms of atomizers are specifically not disclaimed.

All the claims in Ransburg '894 are asserted against the accused devices. Claims 1 and 7 are asserted to be typical. Other than that the heads must be rotatable, the claims are not in terms limited to any particular form of head. Again, while the claims are not in terms limited to heads in which the electrostatic field is the sole atomizing agency, the claims do call for the maintenance between the film edge and the article to be coated of an electrostatic field "of sufficient strength" to draw the film into cusps and to electrostatically atomize particles from the cusps, and disperse and deposit them.

In the specifications it is stated[10] that with a cylindrical head three inches in diameter, operated eight inches from

[10] Column 5, lines 35-44.

the surface to be coated, synthetic enamel was successfully applied, 75,000 volts being used to produce the atomization and precipitation of the material, while the head was being rotated at approximately 150 r.p.m.

Further, on speeds of rotation, and the relative effects of centrifugal force and field strength on degree of atomization and shape of spray, the specifications recite.[11]

> "The speed at which my atomizer is rotated in order to obtain the benefits of the invention will depend upon several factors. If the atomizer axis is vertical with the cusp-tips lying in a horizontal plane, and rotation is employed solely to effect uniformity of distribution, the atomizer may rotate slowly, say at a speed of a few dozen turns per minute. If the atomizer-axis is not vertical and rotation is relied upon to counteract the force of gravity, higher rotational speeds will be employed; but even with the atomizer-axis horizontal and a liquid of relatively low viscosity being atomized, the tendency of the liquid to collect at and near the low point of the atomizer edge can be effectively counteracted by rotating the atomizer at a speed which will subject the liquid to a centrifugal force equal at most to several times the force of gravity. It may be convenient in some cases to employ speeds higher than necessary, as where higher speeds would simplify or lessen the cost of the atomizer-rotating means.
>
> "Experiments establish that such centrifugal force as is imposed on the liquid by my rotating atomizer has far less effect than field-strength on either the degree of atomization or on the shape of the liquid spray, and that if the field has the preferred strength—i. e. an average potential-gradient of the order of 10,000 volts per inch—the speed of atomizer-rotation has no significant effect. For example, if an atomizer like that of Fig. 5 having an annular edge two inches in diameter, is positioned opposite an extended flat plate and an

[11] Column 6, line 64—Column 7, line 42.

electrostatic field having an average gradient of 10,000 volts per inch is created between atomizer and plate, the fineness of atomization and the shape of the spray are substantially the same at 5,000 r.p.m. as they are at 200 r.p.m. But, if under the same conditions, the atomizer is rotated at a constant speed—say 1,000 r.p.m.—and the field strength is gradually reduced by lowering the potential-difference maintained between atomizer and plate, the spray begins to spread and atomization becomes much coarser, which coarser atomization can be prevented by maintaining an adequate potential gradient at the leading edge, irrespective of the polarity thereof.

"I am aware that it has heretofore been proposed in United States Letters Patent No. 1,861,495, granted June 7, 1932, to atomize a liquid by feeding it to a rotating element driven at such a speed that the liquid is broken up into drops as it is thrown from the element by the action of centrifugal force. It is my experience, however, that in such atomizers, even when they are rotated at speeds sufficient to subject the liquid to centrifugal forces many hundred times that of gravity, the atomization is very materially coarser than that which can be produced electrostatically with a field having a potential gradient in the neighborhood of 10,000 volts per inch."

The only claim in which any reference is made to speed of head rotation is Claim 6, which claims the method of Claim 1, "further characterized in that the speed of head rotation is insufficient in itself to produce comparable atomization."[12]

Reference has been made to the hollow center of the spray produced by annular heads embodying the teachings of Crouse '893 and Ransburg '894. In the coating of ex-

[12] Column 8, lines 22-24. Further discussion of this aspect is postponed to the consideration of the question of infringement.

tended surfaces, this caused a variation in coating thickness transversely of the direction of surface movement through the spray. A successful expedient to overcome this defect and to produce a satisfactory uniform coating was to combine the use of several annular spray heads (usually three; a larger inner one, and two smaller outer ones, diagonally disposed toward each other) so that an overlapping would produce a composite coating of substantially uniform thickness. Defendant Proctor is using such a "three-bell" system under license from plaintiff Ransburg.[13]

Simmons, Re. 24,602 seeks to make a virtue of the annular hollow spray pattern of Ransburg '894. The specific systems of Re. 24,602 employ rotating atomizing heads, each arranged on a vertical axis. The articles to be painted are moved in a path around the axis of the spray, and the projection of the spray is generally radial. When the vertical dimension of the article to be coated is large enough to require it, the atomizing head may be reciprocated vertically. The paths of the articles within the spray are shown as essentially circular. The system subjects the articles to be painted to the rim, and not the hole, of the doughnut. The circular path of the articles also permits an extension of the length of time to which the articles are exposed to the spray, allowing the gradual build up of the coating to any desired thickness.

**Validity.**

Defendants do not contend that any cited art anticipates any of the five patents in suit. They do claim that:

1. All five patents are invalid for lack of novelty, or of invention over the prior art;

[13] No objection by plaintiff has been made as to the right of a licensee to contest validity in an infringement suit.

2. Starkey '417 is invalid as double patenting over Starkey '536;

3. Crouse '893 and Ransburg '894 are invalid because of prior public use.

The statutory presumption of validity through the issuance of the patent, U.S.C. Title 35, § 282, is strengthened in this case by:

(a) The tortuous path of the patents through the Patent Office, during the course of which the patents now relied upon by the defendants were considered by the Examiner, and most of them made of record at the foot of the patent; (b) the upholding by the Seventh Circuit of the validity of the Starkey '536 and '417 patents, and obliquely of the validity of the Crouse '893 and Ransburg '894 patents, Binks Manufacturing Company v. Ransburg Electro-Coating Corp., 7 Cir. 1960, 281 F.2d 252, cert, gr. 1960, 364 U.S. 926, 81 S.Ct. 353, 5 L.Ed.2d 265; writ dismissed, 1961, 366 U.S. 211, 81 S.Ct. 1091, 6L.Ed.2d 239; and (c) the very striking commercial success enjoyed by the patents.

The parties seem to be in agreement that Starkey '536 and '417 are the "basic" of the five patents, and that the other three are in the nature of "improvements." In Binks, the Seventh Circuit referred to the Starkey patents as "a broad and basic invention" (281 F.2d at 256), and referred to the rotating bell or disc as a "mere improvement" (281 F.2d at 256), or "at most improvements" (281 F.2d at 261).

It would therefore appear that it should be possible generally to consider the patents relied upon by defendants, rather than discussing them with respect to the individual patents. They are:

E. Pugh 1,855,869 April 26, 1932
Method and apparatus for Coating Articles.

Darrah 1,958,406 May, 15, 1934
Electrical Spraying Device

Gravley 2,359,476 October 3, 1944
Electrostatic Method and Apparatus

Hopkins, et al. 1,861,475 June 7, 1932
Method of Applying Lacquer or the Like

Chaffee, et al. 1,832,096 November 17, 1931
Electrical System

Harper J. Ransburg,
et al. 591,474 (British) August 9, 1947
Apparatus for Spray Coating Articles

Harper J. Ransburg,
et. al. 452,041 (Italian) October 6, 1949
Method and Device for the Electrostatic Coating of Objects.

The first six of these were considered by the Patent Office in the prosecution of the various patents, and were made of record.[14] Darrah and Gravley were considered in Binks, 281 F.2d at 255.

Pugh 1,855,869 discloses a coating system in which finely divided particles are produced by compressed air atomizers, which discharge into a chamber through which the articles to be coated are carried by a conveyor. The atomizers are slightly rearward of, and discharge through holes in, one wall of the chamber. The articles to be charged are at ground potential. The nozzles and chamber walls are positively charged.

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[14] The Starkey '536, the Crouse '893, the Ransburg '894 and Simmons Re. '602 were all assigned to "Cl. 117-93" by the Patent Office; an Starkey '417 to "Cl. 118-51."

The uncontradicted evidence is that the charged wall would substantially shield the atomizer, resulting in a weak field at the point of atomization.[15]

Darrah 1,958,406 discloses electrostatic atomization of liquids by an apparatus in which one or more capillary nozzles or tubes are surrounded by a ring-like electrode between which and liquid in the nozzles or tubes an electrostatic field is maintained. Apparently a spray was claimed to be electrostatically produced and projected beyond the ring electrode. There is no reference to or disclosure of a spray-receiving object to attract or receive the deposition of the spray. The only uses suggested by the patent were in dust collection, and in the promotion of chemical relations between the atomized liquid and the gas into which it was to be atomized.

The references in the Darrah patent to particles which "remain suspended indefinitely in air"[16] and the suggested use of alternating current, which would not be used or usable if deposition were desired[17] negative its application to coating operations. Moreover, Darrah, the holder of some 100 patents, testified by deposition that he had never found any practical use for his invention;[18] and that even after he saw electrostatic painting demonstrated, he had no "ideas as to how [his] apparatus might be made to work."[19]

Gravley 2,359,476 discloses a system for removing excess paint from articles which have been previously painted, as

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[15] Tr. 3443-44; 3453-54. The witness also testified that to the best of his knowledge, Pugh had never been used commercially. Transcript 3442.

[16] Specifications, page 2, line 35.

[17] Transcript, 3437.

[18] PX 258, page 5.

[19] PX 258, page 30. Particularly in view of the well-known claiming proclivity of inventors, this certainly tends to negate "obviousness" of the inventions in suit.

by dipping. By gravity, the excess flows as "tears" to low points, and is drawn from the painted article by electrostatic atomization and attraction to a charged grid. So far as the process is concerned, the excess paint may leave as large drops, small drops, or mist. The process is essentially a decoating one. In such decoating, it is the removal that is all-important; not the size of the drops nor their ultimate disposition or deposition. Perhaps the larger the drop, the quicker and better the detearing. But entirely different problems are presented, and different end results desired, in coating articles commercially. The large drops (slugs) will cause a raised and pitted finish; too small particles will dry too rapidly, and cause unsatisfactory adherence. Further, the object of detearing is to get rid of a fixed quantity of paint once and for all. In electrostatic coating, the atomized paint must be replenished at a uniform and controlled rate. Gravley, rather than teaching the art of the patents in suit, would indicate that electrostatic forces were not suitable for coating.

Hopkins 1,861,475 discloses a centrifugal atomizer in which the coating material is atomized in the form of an extended film from the edge of a rotating cone. The disclosures and claims relate to atomization without the direct action of compressed air thereon, or its admixture therewith. The spray, centrifugally produced, "tends to fly in all directions"[20] and is directed toward the object to be coated "by projecting a hollow jet or stream of compressed air from the gun in the direction of the work and surrounding the spray, so as to form in a sense a sheath or envelope which encloses the spray and causes it to follow a certain course. The compressed air does not constitute an atomizing medium, nor does it even form a carrying medium in

[20] Page 1, lines 61-62.

the usual sense * * *"[21] The recommended speed was 10,000 r.p.m.

Hopkins does not disclose or claim the use of an electrostatic field in any aspect; on the head, at the point of atomization, or for charging or deposition.

Chaffee et al. 1,832,096 was intended to produce electrical charges on discrete particles of matter, such as sand, clay, marble dust, cement dust, and the like, to dissolve clouds and fog, and to produce rain, or to dissipate or dissolve dust clouds, smoke clouds, or the like.

It is difficult for the court to conceive the relevance of the Chaffee citation. Clearly the inventor is not concerned whether the "rain falleth upon the just or the unjust"; nor is the desire to coat, an object of the invention. Further, the last that the inventor or the users of the invention would desire would be the replenishment of the source to be "dissolved or replaced", let alone its replenishment at a uniform rate.

Harper J. Ransburg, et al. 591,474 (British). This patent was cited of record by the Patent Office in the issued patents on '893 and '894. It is particularly "directed to safety equipment and control apparatus for handspraying in an electrostatic field, wherein the spray gun may be grasped and manipulated by an operator * * *"[22] Primarily, the operator, the cage in which he operates, the articles to be coated, and the spray gun are grounded, while the electrode past which the particles atomized by the gun are projected is at high potential.[23] Alternatively, it is stated that the operator and the gun may be of the same potential as the electrode; the

[21] Page 1, lines 67-74.
[22] Complete Specifications, page 1, lines 24-25.
[23] Complete Specifications, page 2, lines 108-112.

electrode may be carried directly upon the gun forwardly thereof in spaced relation.[24]

It is obvious that this is a Ransburg No. 1 Process. The patent refers to "Apparatus for Spray Coating Articles." It does not disclose or claim an electrostatic atomization. At the most, it relates to relative locations of the electrode at which charges are to be imparted. As shown below, under the discussion of infringement, either no, or an impaired, charge could be imparted, where the atomizing gun and the electrode, no matter how associated, are of the same potential.

More particularly, 591,474 (British) does not teach electrostatic atomization, or atomization at the point of highest field strength.

Harper J. Ransburg, et al. 452,041 Italian. Apparently defendants do not contend that its disclosures, which are similar to those of Crouse '893 and Ransburg '894, are anticipatory thereof. They do contend that the Italian Patent either anticipates, or discloses an invention in view of which Reissue 24,602 would be obvious to one skilled in the art. Apparently this contention is based upon Figure 9 which defendants claim shows an atomizer used vertically, between two straight-line conveyors parallel to, but spaced away from, the surfaces to be coated. It is defendants' position that these atomizing heads *may* be (a) reciprocated, (b) rotated and (c) positioned between two conveyors.

As the court construes the specifications, and Figure 9, there is taught the use of an atomizer arranged above a double row of articles moving on a single conveyor, in which the centrifugal and electrostatical forces act in the same direction and not at an angle to each other; and, per-

[24] Complete Specifications, page 3, lines 7-77.

haps more importantly, the reciprocation is used only to position the atomizer *inside* hollow articles. This is completely different from, and not anticipatory of, or teaching, the use of the doughnut pattern as disclosed in Re. 24,602.

The court is of the opinion that the Patent Office was clearly right in holding that the patents in suit are valid in view of the state of the prior printed art.

**The Alleged Dukes Use.**

Defendants assert that apparatus allegedly designed and built by Dukes in 1949 is a substantial anticipation of the Crouse '893, Ransburg '894 and Simmons '602 patents, as a prior public use.

Summary disposition can be made of this contention as to Simmons '602. On the weight of the evidence the court finds as a fact and concludes as a matter of law that Dukes did not position his spray head or heads as was done by Simmons, but sprayed paint vertically to a moving conveyor.[25] In any event, the second device, relied upon by defendants, functioned unsatisfactorily,[26] and could not be considered anticipatory of Simmons, which, on the testimony and as witnessed by the court, is an eminently satisfactory operation.

Dukes had been employed by a very well-known manufacturer of air gun spray type equipment. In 1946, Dukes decided to go into business for himself. Prior thereto, he had worked on the design of a centrifugal disc spray device. He began his independent operations with air gun spraying, dipping and flow coating, and then began to experiment with centrifugal rotating disc atomizers. Various modifications of spacing between the discs, and different feed

[25] Transcript, pages 2295-97.
[26] Transcript, page 1955.

systems, were tried. These sprayed vertically to a moving conveyor. Dukes testified that in 1948 or 1949[27] he used an electrostatic field, directly charging the gun and the work. The specific devise relied upon by defendants was, fortunately or unfortunately, allegedly destroyed by a fire in 1953. Importantly and remarkably, Dukes although still in the job painting business, has never since returned to the equivalent of the Simmons '602, nor, apparently, to the Ransburg '894.

Significantly, as will be developed under the question of infringement, Dukes found that the particle size in all his operations, decreased with the field on[28]; and it never occurred to him, despite his wide experience, to use electrostatic forces in painting until he saw the Ransburg applications.[29]

It is extremely doubtful if the evidence as to the alleged Dukes prior use, even as above limited, could be considered as proof "clear, satisfactory, and beyond a reasonable doubt", Washburn & Moen Mfg. Co. v. Beat 'Em All Barbed Wire Co., 1892, 143 U.S. 275, 284, 12 S.Ct. 443, 36 L.Ed. 154; Hoeltke v. C. M. Kemp Mfg. Co., 4 Cir. 1935, 80 F.2d 912, 923; Colgate-Palmolive Co. v. Carter Products, Inc., 4 Cir. 1956, 230 F.2d 855, 861. Were it necessary, the court would find as a fact, and conclude as a matter of law, that the proof offered did not meet the above requirements as to Crouse '893 and Ransburg '894.[30] However, it is clear that in any event the effective dates of the '893 and '894 patents (March 5, 1948 and October 29, 1948, respectively) well

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[27] 1949 is clearly the earliest possible date, as it was only then that he acquired his first "power pack", permitting the imposition of positive and negative charges.

[28] Transcript, page 2023.

[29] Transcript, page 2031.

[30] Simmons '602 has already been ruled out factually, even accepting the Dukes' testimony as credible.

precede any possible date attributable to Dukes. Each was a continuation-in-part application—an application which contained both subject matter taken from an earlier application, and new subject matter not disclosed in the earlier application. No contrary significance can be drawn from the date shown in the heading of a patent resulting from a continuation-in-part application, which is always that of the continuation in part, never that of the original application. Ex parte Ellis, 1919, C.D. 64, 264 O.G. 863, Ex parte Komenak, 45 U.S.P.Q. 186. The cusp-forming feature of the electrostatic field had been disclosed in the 1948 parent of the '893 and '894 patents.[31] The '893 and '894 claims in suit are entitled to the parents' filing dates. Davis Co. v. Baker-Cammack Hosiery Mills, D.C.M.D.N.C.1949, 86 F.Supp. 180, 186, aff'd., 4 Cir. 1950, 181 F.2d 550, 558.

**Double Patenting.**

Defendants contend that the Starkey '417 apparatus patent is invalid as "double patenting" over the Starkey '536 method patent. This contention was also made in the Binks case, and decided adversely to the position of defendants, Binks Manufacturing Co. v. Ransburg Electro-Coating Co., 7 Cir. 1960, 281 F.2d 252, 257, on reasoning entirely satisfactory to this court. See also, Hartford-Empire Co. v. Obear-Nester Co., 8 Cir. 1934, 71 F.2d 539, 561; Fehr et al. v. Activated Sludge Co., 7 Cir. 1936, 84 F.2d 948, 957.

The court therefore concludes that the patents in suit are, and each of them is, valid. In the court's opinion, the validity of the patents is clear. Were this a "close" case on the question of validity, the striking and unusual commercial success (Hutzler Bros. Co. v. Sales Affiliates, 4 Cir. 1947, 164 F.2d 260, 267; Florence-Mayo Nuway Co. v. Hardy, 4

[31] PX 47 A, page 3; PX 48 A, page 7.

Cir. 1948, 168 F.2d 778, 781; B. F. Goodrich Co. v. United States Rubber Co., D.C.Md. 1956, 147 F.Supp. 40, 73, affirmed 4 Cir. 1957, 244 F.2d 468) and the tribute of praise to the prior art but the tribute to the patent by defendants' copying (Diamond Rubber Co. of New York v. Consolidated Rubber Tire Co., 1911, 220 U.S. 428, 441, 31 S.Ct. 444, 450, 55 L.Ed. 527; Ackermans v. General Motors Corp., 4 Cir. 1953, 202 F.2d 642, certiorari denied 1953, 345 U.S. 996, 73 S.Ct. 1139, 97 L.Ed. 1403, rehearing denied 1953, 346 U.S. 842, 74 S.Ct. 16, 98 L.Ed. 362; Florence-Mayo Nuway Co. v. Hardy, 4 Cir. 1948, 168 F.2d 778, 782) would easily weigh the scales in plaintiff's favor.

**Infringement.**

In the early 1950's, after the Ransburg No. 1 Process had been on the market for a number of years, the Sedlacsiks, under the name of Scientific Electric Company, (Ionic) began the sale of an electrostatic spray-coating system using a compressed air spray gun.[32] After the Ransburg No. 2 Process became publicly known, following its 1951 public disclosure, the Sedlacsiks built and exhibited an airless electrostatic spray-coating system, employing an atomizer, later known as the Model 12. That atomizer had a rotating, conical, electrically charged head, on which the paint was formed into a film, and fed to the rim of the head, by centrifugal force, and from that rim was atomized, dispersed and deposited under the influence of a high-voltage electrostatic field maintained between the head and the work. In 1956, the Sedlacsiks began exhibiting a second atomizing device, known as the Model 50, which likewise

[32] This was a studied, and apparently successful, technical modification that avoided literal infringement. This has been indicative of Ionic's procedure—noncreative, but evasive. If successfully evasive, it is of course legal; but it does not elicit a sympathetic or liberal approach; as subsequent matters of credibility will re-emphasize.

employed centrifugal force to feed the paint in a film to the rim of a rotating electrically charged disc or bell-shaped atomizer. Whether the atomization therefrom is purely centrifugal, purely electrostatic, or an aggregation or a combination of the two, and if so in what significant proportions, is the basis of dispute on the question of infringement.

After this suit was started, Ionic began selling a third form of atomizer, known as the Model M-50, which comprised two Model 50 devices on a common support. Plaintiff charges that all three, Models 12, 50 and M-50 are infringements of the patents in suit.

In 1955, defendant Proctor was using, under license from plaintiff, the Ransburg No. 2 Process in the painting of ironing boards with equipment employing a plurality of rotating heads disposed on horizontal axes and arranged to project over-lapping conical sprays axially toward ironing table parts moved through the sprays in a straight path. At Proctor's request, plaintiff designed an additional No. 2 Process installation employing a plurality of rotating atomizers disposed on vertical axes, and a conveyor of the type shown in Re. 24,602 for carrying ironing board tops in a circular path around the atomizers. In 1955, plaintiff submitted to Proctor drawings and other data relative to such equipment, and accompanied such data with a proposed license contract covering installation and use of the proposed system. Proctor did not accept the contract submitted by plaintiff. Instead, Proctor entered into negotiations with Scientific Electric Company, and after several months, and after the disclosure of the general nature of Proctor's negotiations with plaintiff, was shown a Model 50 device. Proctor eventually purchased two Model 50 atomizers (on a hold-harmless agreement) and incorporated them into an installation which, except as to the contour of

the path to be traversed by the work, was a duplicate of the additional No. 2 installation designed and submitted by plaintiff. The infringement with which Proctor is charged is the use of equipment which includes the two Ionic Model 50 atomizers.

All of the systems accused as infringements of the patents in suit embody one or more rotating atomizing heads which spread liquid coating material fed at a controlled rate into a thin, uniform film presented circularly to an electrostatic field created by applying a negative electrical potential, usually in the nature of 90 KV, to the atomizing head while the articles to be coated are maintained at ground potential in positions spaced from the head at distances such that arcing will not occur. Except perhaps with respect to liquid coating material which is not readily electrostatically atomizable[33], at the rim of the head the field is of liquid-atomizing strength. The field is therefore "of sufficient strength to" electrostatically atomize, or "capable of" such atomization. In such field, the edge of the film is formed into a series of spaced cusps, the tips of which repeatedly and continuously break off to form fine, electrically charged particles, which are electrostatically deposited on the work by the electrostatic field. At the tips of the cusps, where atomization takes place, the field is strong, and the lines of force are highly concentrated. Each particle, as formed, bears a substantial and effective "in-born" or "built-in" electrical charge, as the result of which the particles are electrostatically urged to follow the lines of force toward deposition on the work.

Defendants contend that all of plaintiff's patents (except Simmons Re. 24,602) require that the paint "is and must

[33] There was no evidence that defendants commercially, or ever, used coating materials which were not, in business operations, readily electrostatically atomizable.

be atomized through electrostatic forces *alone* to the *exclusion of any other force.*"[34] This is based upon the alleged limitations in the claims (heretofore discussed) in said patents, and by their history as disclosed in the various file wrappers. In substance, defendants claim that with knowledge of the limitations of the prior art, they deliberately departed from the idea of electrostatic atomization, and developed the accused devices, which they contend constitute centrifugal, as distinguished from electrostatic atomizers.

The contention of deliberate and learned departure from electrostatic atomization, and the development of centrifugal atomizing devices, deserves and will receive summary disposition. Sedlacsik, Jr. testified as to his thorough search, anticipatory of such alleged development, of the patent files in the New York Public Library in 1949, describing the physical layout of the patent section, and the way in which various patents were assembled and bound. Subsequent evidence, not challenged, showed a filing system in the Library so different at the time of the alleged search from that described by Sedlacsik that his testimony is unworthy of belief, and is unacceptable to the court.

Secondly, all of defendants' devices do call for a charge on the atomizing head. As will later be considered in more detail, defendants claim that nevertheless the atomization is centrifugal only. For reasons to be stated, the court finds to the contrary.

Third, on July 14, 1959, on an application filed August 18, 1958, there was issued to J. Sedlacsik, Jr. Patent No. 2,894,485, "Apparatus for Electrostatically Applying Multi-Coatings". This discloses a variety of atomizer arrays "each employing one or more atomizers and one or more

[34] Transcript, page 4267, emphasis supplied.

deflector heads which may be rotary and/or electrostatic."[35] A conventional high voltage source is connected between ground and the atomizers.[36] Normally paint is centrifugally moved to the peripheral edge of the atomizing disc where it "is atomized due to the centrifugal action *and the electrostatic charge* of the particles * * *"[37] Claims 1, 7, 15, 16 and 20 relate to atomizing heads with "an electrostatic field between said atomizer array and said articles for atomizing and depositing said coating materials on said articles * *" The M-50 admittedly is within this patent coverage. The court is unable to understand how the use of an electrostatic field related to a charged atomizing head "for atomizing" can represent a studied and successful (!) effort to get away from electrostatic atomization and solely into centrifugal atomization; or why an electrostatic force should atomize paint on a Sedlacsik device, but not on plaintiff's devices; or why, if atomization is to be, and will be, solely centrifugal, any charge is placed on the atomizing head.

The question of file wrapper estoppel or limitation of plaintiff's claims through Patent Office procedure is difficult to summarize. As stated, it is defendants' position that plaintiff's patents are all limited to electrostatic atomization through electrostatic forces alone, to the exclusion of any other force. It is possible technically to dismiss this contention in its literal sense by pointing out that the Patent Office in allowing claims for any device except a stationary one, necessarily allowed claims calling for a force other than electrostatic force alone; a rotating head of necessity introduces *some* mechanical force. In an effort to escape this dilemma, defendants' counsel argued that centrifugal force could be used with the field on, resulting in electro-

[35] Column 1, lines 33-35.
[36] Column 3, lines 1-2.
[37] Column 3, lines 44-51; emphasis supplied.

static atomization up to the speed at which centrifugal atomization would have occurred had there not been a field; at any and all higher speeds, atomization was no longer electrostatic (within the patent coverage) but centrifugal (outside the patent coverage). Plaintiff claims that as long as the paint is made the electrode, or the paint is atomized at the point of greatest field intensity so that the benefits of the "in-born" or "built-in" charge are obtained, the patents are infringed whether or not, and if so at what rate, rotation occurs.

The court concludes that the Patent Office procedure does not support defendants' contentions, in the literal, or their somewhat broader, aspects. Whether they support the contention of plaintiff in its broadest aspects it will not be necessary to decide.

In the prosecution of the '894 patent, all the claims were rejected by the Examiner on a hypothetical aggregation of Crouse with either Hopkins or Chaffee.[38] He concluded that "It is not seen to be inventive to use Hopkins' spreading means, i. e., rotating means, in Crouse's apparatus or to use Crouse's charging means in Hopkins' apparatus"; and that "no invention is seen in rotating Crouse's gun according to the teachings of Chaffee whose disclosure shows the charging of liquid particles in a gun similar to that of Crouse except that it is rotated to distribute the material to be charged."[39]

The action of the Examiner was appealed to the Board of Appeals. At the hearing before the Board, appellant offered motion pictures showing applicant's atomizer and that of the Hopkins reference in action. The hearing room

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[38] Other grounds were advanced by the Examiner, but were abandoned.

[39] PX 48 B, page 71.

could not be darkened;[40] the pictures were projected, but visibility was so poor that leave was given to file "stills" from the individual frames of the motion picture films. This was done.[41] These showed, with respect to "open" articles, such as one-inch metal tubes disposed on three-inch centers, that with a cup-shaped atomizing head described in the appealed claims, with a head speed of 900 r. p. m. and a head potential of 100 KV, the paint was finely atomized. Some of the paint, under the influence of the momentum acquired from electrostatic forces during the movement from the head, passed between the adjacent tubes, and then, still under the influence of the lines of force, changed its direction and was deposited on the rear of the tubes.

Another "still" showed a scaled reproduction of the head shown in Fig. 2 of the Hopkins reference. It had a head speed of 10,000 r. p. m. (the speed recommended by Hopkins) and a head potential of 100 KV and an air pressure ring at 15 p. s. i. Despite the effect of the electrostatic field, much of the paint was carried past the work and lost as overspray, due to the force of the air sheath.

Another "still" was taken under the same 10,000 r. p. m. and 15 p. s. i. conditions but with the head uncharged. A substantial overspray loss again occurred, and in addition, the air sheath (unaided by electrostatic forces) was unable to divert all the centrifuged paint even toward the target, some paint being thrown centrifugally through the air sheath and falling to the floor between the head and the target (or work).

In a six-page opinion, the Board of Appeals affirmed the

[40] Persons accustomed to the most complex patents apparently could not solve an ordinary problem, even by moving to another room.

[41] PX 48 B, pages 168-171.

Examiner, saying that "the examiner has properly combined the references and that such combination anticipates the appealed claims."[42] The Board admitted that if Hopkins were modified merely by charging the head, appellant's criticism of loss of paint by "overshooting the work" was valid, but suggested that "the air stream may well be omitted * * *" ![43]

That appellant would not readily be satisfied[44] with this decision, or the basis thereof, may well be imagined. A civil action was filed in the United States District Court for the District of Columbia. Before the case came to trial, a conference was had with the Primary Examiner. He was favorably impressed with the contention that while the Board of Appeals had apparently concluded that since either an

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[42] PX B, page 175. "Anticipation" by an hypothetical combination or aggregation seems extreme. Possibly the Board meant lack of novelty was shown.

[43] PX 48 B, page 175.

[44] Neither the Examiner nor the Board claimed that Crouse, Hopkins or Chaffee provided any criteria in their disclosures for these ex post facto selections, assemblies and omissions. Hopkins was concerned exclusively with centrifugal atomization, and the use of an air sheath to prevent the particles from being thrown off radially, and to direct them toward the work. He contemplated no grid or field, much less a charged atomizer. Moreover, it is at least doubtful if the atomizer could successfully work if charged, as it appears to be shielded, which would eliminate or greatly reduce the field. To eliminate that which was essential to Hopkins, in order to add something he did not contemplate or desire, and possibly could not use, is an extremely tortuous and attenuated approach to invalidate claims.

At least as remote is the aggregation of Hopkins and British Ransburg 591,474 which defendants contend is the equivalent of a Model 12. As pointed out in the discussion of that patent, supra, it is primarily a Ransburg No. 1 Process. It does not teach electrostatic atomization, or atomization at the point of greatest field strength.

If defendants wish centrifugally to atomize and project spray through a grid, as in Ransburg No. 1 Process, they are probably free to do so. However, in all instances they apply the field directly to an unshielded head, as taught by the patents in suit.

electrostatic field or centrifugal force can atomize liquid, applicant's claims were directed to nothing more than an aggregation of the atomizing effects of electrostatic and centrifugal forces; applicant in fact used centrifugal force to present the liquid to the field in such a form that the field was able to produce finer atomization; a combination, rather than an aggregation.

There were produced and filed two photographs,[45] showing the operation of the claimed invention using a bell-type and a disc-type atomizer.

The bell had a diameter of four inches, rotating at a speed of 900 r. p. m., and with an electric potential of 100,000 volts. The disc had a diameter of twenty inches, rotating at a speed of 2,000 r. p. m., and with an electric potential of 100,000 volts. In each instance the formation of cusps and the atomization and dispersion of particles from the tips thereof under the influence of the field was apparent. While certainly the rotation of a twenty-inch disc at 2,000 r. p. m. would produce some centrifugal atomization, it was claimed that the centrifugal force existing in either atomizer was far below what would have been required to produce centrifugal atomization of the fineness shown in the photographs.

Thereafter a new application was filed as a continuation of and a substitute for the current application, and it was allowed without amendment as the '894 patent, and the suit in the United States District Court for the District of Columbia was dismissed.[46]

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[45] PX 48 B, 186, 187.

[46] After allowance but before issuance the title was changed from "Method and Apparatus for Electrostatically Atomizing Liquid" to "Method and Apparatus for Electrostatically Coating" on the representation that "* * * the allowed claims are not directed to an electrostatic atomizing system but rather to a complete coating method or apparatus in which an atomizing step, or an atomizer is only one of the recited features." PX 48 C—pages 37-38.

Certainly this procedure in the Patent Office did not limit the scope of plaintiff's patents to claims in which the paint is, and must be, atomized through electrostatic forces alone, to the exclusion of any other force. The centrifugal force represented by rotation of a twenty-inch disc at 2,000 r. p. m. is certainly *some* force other than electrostatic force alone; and at least the participation (and assistance, in the sense of forming, thinning and presenting the paint to the field) of centrifugal force is too clear for argument.

The court is of the opinion that the minimum clearly allowable to plaintiffs as the result of the Patent Office prosecution is that plaintiff's patents cover any case in which the paint, as presented to the field (by gravity,[47] or centrifugal force) is then atomized under circumstances in which electrostatic forces either predominate, or form a significant factor.

Defendants admit that in their Model 12 device, "[p]erhaps the electrostatic field has a minor effect upon the atomization."[48] They claim, however, that as there is a concurrence of centrifugal force with electrostatic forces, there can be no infringement—an approach which the court has rejected.

Alternatively, defendants contend that in fact, in the operation of the accused devices, the atomization is not electrostatic, but centrifugal. This is based in part upon the testimony of Sedlacsik, Jr., but primarily upon the testimony of two "experts"—Dr. Charles L. Mantell and Harry J. Green. Sedlacsik, Jr. and Dr. Mantell were open advocates; Green a less obvious one. Their testimony is not convincing, per se, or in the light of visual demonstrations and exhibits.

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[47] Which might itself be considered a "force" non electrostatic in nature.

[48] Final brief, page 31.

Sedlacsik, Jr., Mantell and Green each testified that in the commercial operations conducted by defendants, the paint was not on the charged atomizing head long enough to receive a[49] charge; the atomization was solely centrifugal. The particles so atomized were then charged by the "field"; apparently primarily immediately adjacent to the edge of the rotating head, where a corona-like field existed; but in part the charging might occur along the pathway of the particle toward the work.[50] Mantell and Green further testified that under the influence of the field, originally centrifugally formed particles might further atomize—which, if true, would seem to be electrostatic atomization, although Mantell denied this.

This testimony seems to mean that the paint, at a peripheral speed of 133 m. p. h. at the edge of the head, and electric forces, moving at 186,000 miles a second, both leave the edge of the head without any charge being imparted; but immediately upon centrifugal atomization occurring, most of the articles receive a charge. Admittedly, in the paints ordinarily used, with the field on, electrostatic atomization occurs when the head is stationary; and it occurs when the head is rotated at any speed just short of that where centrifugal atomization would take place if the head was not charged. In these cases, the electric charge

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[49] Dr. Mantell was not entirely consistent. At one point he seemed to indicate that the paint might receive a partial charge at the rim of the atomizing head, but that such charge would be insufficient to effect electrostatic atomization.

[50] The charging, for purposes of dispersion and deposition, out of the line of greatest electrostatic intensity, is a concept presenting some difficulty to the court, particularly where the face of the head is parallel to the work. The result of purely centrifugal atomization would be the throwing of particles off the edge in a circular pattern, none of which would be likely to reach the work. If the centrifugal force were sufficient to throw particles through the field at its point of greatest intensity, without receiving a charge, it is hard to understand why they would, travelling away from the field, later come under its influence.

has "time" to charge and electrostatically atomize the paint. But defendants contend that as soon as a rate of rotation sufficient centrifugally to atomize is reached, then whether the head is charged or not, the atomization becomes solely centrifugal.

On some of the heads, 900 r. p. m. seemed the point at which centrifugal atomization would occur. According to defendants' position, at 0 r. p. m., 1 r. p. m., etc. up to 900, the atomization is electrostatic (centrifugal force merely presenting the paint to the rim in a continuous film for electrostatic atomization); but at 901 r. p. m. centrifugal force takes over and ousts the charge as an atomizing agent; the paint does not stay on the head or at the rim a time long enough to be atomized: Were this the case, there would be no point in charging the head; the creation of a field immediately adjacent the edge of the head would suffice.[51] But defendants do charge the heads, despite the insulating problems so created.

This effort to use the teachings of the Ransburg patents but to deny their efficacy is suspect.

When the first accused Ionic system was initially brought out, head speeds were low. In an early magazine article, Sedlacsik, Jr. described the speed of the Model 50 as "variable from 400 to 2,000 r. p. m." During 1956 and 1957, the Model 50 speeds recommended to customers were in the 1,150-2,500 r. p. m. range. In January 1958, Sedlacsik, Sr. said that with respect to the Model 12, speed "is not important. Anywhere from several hundred to several thousands." In January 1958, Sedlacsik, Jr. deposed that the

[51] In fact, Green testified that in his opinion a modification of Ransburg No. 1, in which paint was centrifugally atomized and thrown into a grid field, would be better; there was a loss by placing the field at the "top" of the disc.

standard speed of the Model 12 was 1,500 r. p. m., although it was capable of variation from 0 to 4,000 r. p. m.

During the trial, as the defense of centrifugal atomization developed, it was testified that the recommended Model 12 speed "in most cases" was 4,000 r. p. m. and could reach 7,000 r. p. m. The trial testimony was that the other (disc-type) heads normally operated "in most cases" at 2,000 to 4,000 r. p. m.

During the trial of the case, Sedlacsik, Jr., in his effort to show how completely centrifugal force overcame electrostatic forces, testified[52] that at speeds where centrifugal atomization would take place, 25 to 50 per cent of the particles are mechanically projected and deposited on the work, the electrostatic field having no influence on them at all. He was asked how, if this were the case, some of these particles were not cast in the direction of the spaces between articles to be painted, and so would pass through, and be lost. He replied that with the field on, "being the particles are cast through the charged zone, they pick up a sufficient charge to effect wraparound of any particles that would be normally going through the part, beyond the part."

He repeated this testimony, saying:[53]

"In other words, what I am trying to say is that any particles which would be—well, let me explain it this way: Without the electrostatic field, you are depositing X amount of particles on the object, and the balance of these particles would be driven through and would deposit or fall out on to the floor; whereas when the electrostatic field is applied in that case, the particles which would normally fall out

[52] Transcript, pages 2642-2648.
[53] Transcript, page 2646.

would be precipitated over to the object either directly in front of it or effect wraparound."

Perhaps the most charitable interpretation of this would be to call it absurd. According to Sedlacsik, Jr., all particles start centrifugally atomized and uncharged. All pass through an electrostatic field. Those (some 25 to 50 per cent) which by mechanical force happen to be directed so that they would hit a moving target remain uncharged. Those which by virtue of their direction would miss the moving target become charged, and so are deposited either directly, or as wraparound. The basis of selectivity by which the field determines those not properly aimed, and kindly charges them and them alone, and passes by the others, is not disclosed or suggested. Somehow or other, the mechanically properly aimed particles carry little "Keep off" signs, and those that would be lost have "Help wanted" signs; which signs are invariably read, understood and obeyed by the electrostatic field.

To the court, the contention of plaintiff is far more plausible that when the field is on and the head is not shielded, with or without rotation, the atomization is electrostatically effected, or at least occurs at the point of greatest field intensity; that all particles are given their charge at that time, and then follow their predestined course along the various lines of force from the head to the work.

Green admitted that his theory that at high rates of rotation the paint did not remain on the head long enough to receive a charge, and that the charge was imparted as the particle traveled from the head toward the work, and that further break-up occurred in flight, did not occur to him until after the trial had begun. It developed after the trial had begun. It developed from his observation of the

operation of Ionic devices and his study of high speed pictures of such operations, and of various spot sizes found on "zip strips."[54]

This post litem motam theory might well be compared with the statements by Green in the application for a patent on the Ransburg No. 1 System, of which Green was a co-inventor, in which it is said that where "the gun itself is the discharge electrode * * * all particles of the spray may then *be expected to be electrically charged* * * *"[55]

Green admitted that he had had no experience with centrifugal atomization, and several times wondered why he was being retained by defendants, and how he could help. Apparently he found out, in time to testify.

Despite his professional background, the court doubts Dr. Mantell's qualification as an expert in this case.[56] He

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[54] So called because solid strips of paper or aluminum would be placed between the head and the work, and then quickly pulled or "zipped" away. A number of particles would be intercepted, and deposited on the strip.

[55] Patent No. 2,247,963, issued July 1, 1941 to Harold P. Ransburg and Harry J. Green, column 1, lines 36 to 38. Emphasis supplied.

[56] In over 88 pages of the Transcript (3067-3154) largely intended to indoctrinate the court into the mysteries of the electrostatic field, with blackboard and a "Listen My Children and You Shall Hear" technique, he insisted that an ampere is "the quantity of silver deposited per second" (3070, 3153-3154) and that "no voltage is set in that relation." (ibid.); that this was the Bureau of Standards definition.

The definition to which Mantell apparently intended to refer was that found in 15 U.S.C.A. § 221 before repeal in 1950, in which the ampere is defined as "the practical equivalent of the unvarying *current,* which when passed through a solution of nitrate of silver in water in accordance with standard specifications, *deposits silver* at the rate of one thousand one hundred and eighteen millionths of a gram per second." (Emphasis supplied).

Under Mantell's definition it might well be asked: "How many amperes in a dime, Doctor?"

The volt, the unit of electromotive force, was then defined, 15 U.S.C.A. § 221, as "the electromotive force that, steadily applied to a conductor whose resistance is one international ohm, will produce a current of an international ampere * * *."

testified[57] that in electrostatic atomization, cusps formed in radial lines, projecting almost radially outward, and at the end the cusp breaks into droplets. In centrifugal atomization "cusps" form, curl, a drop or "tadpole" is formed, larger than the ligament (umbilical cord) attaching it to the mother liquid, and it is then torn or whipped off. Apparently the umbilical cord retracts, and the process is repeated. He further testified that on the high speed motion pictures of defendants' devices in operation, some of both types of atomization could be seen—(in which event the atomization is clearly not wholly centrifugal). However, he flatly refused[58] to examine stills taken from these very motion pictures and say if they were taken with the field on or off—a determination that the court was able successfully to make for itself some months later at the argument, and without having first referred to the labels.

His "clincher" that atomization on Ionic devices was centrifugal was that only about 100 watts of power were supplied to the field, while a one-half horse power motor (378 watts) was used to rotate the head, therefore the effectiveness of the centrifugal force must be approximately four times that of the field, is a patent non sequitur.

That Mantell was an advocate was demonstrated in his insistence that electrostatic atomization existed only if the disrupting electric force were imparted and received at the face or edge of the head. In his opinion, if a drop were formed mechanically, and was further broken up in and by the field; or if the charge were transmitted from the atomizing head through the umbilical cord to a centrifugally formed drop, and the drop thereby disintegrated, neither

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[57] Transcript, pages 3236-3237.
[58] Transcript, pages 3253-3255.

of these was electrostatic atomization.[59] To the court, particles that are electrostatically atomized are formed as the result of electrostatic atomization, no matter where they are so atomized.[60]

Although insisting that the atomization at 2,500 r.p.m. on a fifteen-inch disc was purely centrifugal, Mantell did say that the existence of a field on the disc made it easier to atomize mechanically; that a charge might be transmitted from the disc through the umbilical cord to a drop, causing its disintegration; and that (along with Green) further atomization after leaving the disc might be effected by the field—each of which certainly negatives purely centrifugal or mechanical atomization, and all of which strongly indicate, if, they do not in fact require, the conclusion that defendants are using plaintiff's patents and at least getting some benefit from them.

The plaintiff's expert, Dr. Emery P. Miller, was far more persuasive both in the manner and content of his testimony. His statement was not contradicted that with voltage applied to the head of the atomizing device (disc or bell) under any of the commercial aspects practiced by the parties, the spot size of the atomized particles was always smaller, at any particular speed of rotation, than at the same speed of rotation at no voltage.[61] This would show that the effect of electrostatic forces on atomization was never completely superseded or blanked out by centrifugal force. The court accepts this testimony, and draws

[59] Transcript, pages 3241, 3251.

[60] Mantell was also obviously in error in his conclusion that the centrifugal force at the periphery of a four-inch disc rotating at 5,000 r. p. m. would be greater than that at the periphery of a two-inch disc rotating at 10,000 r. p. m. Transcript, page 3232; see rebuttal, Transcript pages 3590-3594.

[61] See PX 100. Dukes, called by defendants, testified to the same observations.

the conclusion indicated. This would seem sufficient to constitute infringement under the holding in Tilghman v. Proctor, 1880, 102 U.S. 707, 26 L.Ed. 279—a case strongly relied upon by plaintiff in briefs and argument, but as to which defendants have attempted no answer or differentiation.

Tilghman's patent dealt with a method of creating fatty acids from fats. In the prior art this had been done by a process involving the treatment of fats with both water and lime in an open vessel, sometimes with the introduction of superheated steam, at temperatures below the boiling point of water. Tilghman discovered that the same result could be obtained by eliminating the use of lime, and treating the fats with water only, in a closed vessel at a temperature well above the boiling point of water (612° F. being preferred) but under sufficient pressure to prevent the water from boiling. His patent claimed "• • • the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure."

The defendants in Tilghman used water, and lime in the proportions of 4-7 per cent (in place of the prior art 12-14 per cent), in admixture with fat, and a temperature of 310° F. In holding this to be an infringement, the court said:

> "• • • They use water in admixture with fat, heated to a high degree, far above the boiling point, and yet subjected to such pressure as to prevent the water from being converted into steam; and though they may also use other things at the same time, which other things may facilitate the operation, or render a less degree of heat necessary than would be required when water alone is used, and thus actually improve the process of Tilghman; yet this process is included in their operation, and forms the basis of it. It is idle, therefore, to say that they do not infringe Tilghman's patent. It is unnecessary to determine what precise

part the lime used by the defendants plays in their process; whether, as the complainant contends, it saponifies the fat to a certain extent, leaving the remainder to be acted upon by the water alone purely after the process of Tilghman; or whether, as the defendants contend, the lime produces a more perfect and active commixture of the fat and water, or predisposes the fat to unite with the requisite elements of water necessary for producing glycerine and the fat acids—in either case the process of Tilghman, modified or unmodified by the supposed improvement, underlies the operation performed in the defendants' boilers." (102 U.S. 731-732, 26 L.Ed. 279).

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"* * * It is probably true, as contended for by the defendants, that by the use of a small portion of lime, the process can be performed with less heat than if none is used. It may be an improvement to use the lime for that purpose; but the process remains substantially the same. The patent cannot be evaded in that way. The matter may be stated thus: Tilghman discovers a process of decomposing fats by mixing them with water, and heating the mixture to a high temperature under a pressure that prevents the formation of steam. It is a new process, never known before. The defendants seeing the utility of the process, and believing that they can use a method somewhat similar without infringing Tilghman's patent, put a little lime into the mixture, and find that it helps the operation, and that they do not have to use so high a degree of heat as would otherwise be necessary. Still, the degree of heat required is very high, at least a hundred degrees above the boiling-point; and a strong boiler or vessel is used in order to restrain the water from rising into steam. Can a balder case be conceived of an attempted evasion and a real infringement of a patent?" (102 U.S. 733, 26 L.Ed. 279).

But it is not necessary to decide this case by choosing a winner in the battle of the experts. In the court's opinion,

irrefutable evidence, apart from opinions, exists that in none of the operations practiced by either plaintiff or defendants is electrostatic atomization eliminated. Reference has been made to the distinctive appearance of the cusps in purely electrostatic atomization from that of the "cusps" or balls or "tadpoles" incident to centrifugal atomization.[62]

First: High speed photographs[63] showing the forms assumed by the liquid at the rims of heads rotating at and above the speeds at which defendants' witnesses contended centrifugal force suppresses (eliminates) electrical atomizing effects, clearly show the persistence of electrostatic atomization.

Second: Motion pictures were exhibited by defendants of dual disc operations (M-50), the Model 12 and the Hopkins nozzle at various speeds and voltages. Because of the positions at which defendants had directed that the camera be placed, and the amount of, and lack of control over, the paint fed, definition at high speeds was equivocal. If it did not clearly identify electrostatic atomization, with the field on, it certainly did not establish its suppression. At lower speeds, the characteristic electrostatic atomization could be clearly observed.

One striking occurrence did take place. Motion pictures of the operation of a No. 12 device, at 350 to 6,000 r.p.m. with and without a field, were exhibited. One sequence was titled as showing the operation at 6,000 r.p.m. with 0 voltage, and another at 6,000 revolutions with 100 KV. Dr. Miller, observing the pictures, noticed the "tadpole" structures in the sequence supposed to be with voltage on, and

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[62] Plaintiff graphically, but with over-simplication characterizes electrostatic atomization as resembling a machine gun discharge, and centrifugal atomization as resembling sling shots.

[63] E. g., PX 97, 98, 102, 233, 236.

the characteristic electrostatic atomization in the sequence supposed to be with voltage off. He concluded that the labels or titling had been reversed. This was admitted by defendants. The court does not believe the error to have been intentional. It does show that recognizable differences existed between the two forms of atomization so unmistakable that a trained observer could distinguish, despite the labels; and that electrostatic atomization persisted at 6,000 r.p.m.

Third: The M-50 consists of two similar discs, of varying sizes. Normally they are spaced four inches apart, rotate in the same direction, and carry similar charges of like polarity. Since like charges repel, it would be expected that the field between the discs would be cancelled out, or at least be weaker than on opposite sides of the discs. Such is the fact.

In the course of defendants' demonstrations of the M-50 in action, the court observed[64] that there was a definite deposition of paint on the floor of the booth, heaviest in the space immediately between the two discs, and then fanning out noticeably for a radius of two and one-half to three feet, and then rapidly thinning out with some fine deposition up to the throat of the booth. There also appeared to be a cloud-like build-up between the two discs. Defendants argued that this had nothing to do with atomization, but only with an inadequate charging of the articles after formation. However, a high speed photograph[65] of all of one disc, and a portion of the other, clearly shows a mixture of centrifugal and impaired electrostatic atomization in the roughly 90° sections of the disc circumferences nearest each other, and purely electrostatic atomization in the remaining 270°.

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[64] Transcript, page 565.
[65] PX, 101 B. 203 F.Supp.—17.

Fourth: In view of defendants' theory that paint would not, at high speeds, remain on the surface long enough to be charged, and that particles were formed entirely by centrifugal force and acquired their charge in space, plaintiff prepared apparatus to test it. This apparatus was essentially a Model 50 system, except that two sharp-edged washers were installed, one immediately over and the other beneath the disc, each extending outwardly beyond the disc edge. The disc and the two washers were connected to the high voltage source, the washers thus acting as shields, and preventing any effective charge on the paint, and any atomizing field gradient at the disc edge.[66] The paint deposited with the washers removed (the normal Model 50 operation) was 75 per cent greater than when the disc was insulated and the washers provided the field. The ignorant paint apparently found that it *did* have time to acquire a charge while on the disc under ordinary operating conditions.

The court finds as a fact, and concludes as a matter of law, that the accused devices in operation do not atomize exclusively by centrifugal force, and do not supersede electrostatic atomization. Defendants concede that a charged disc assists centrifugal atomization. Plaintiff recogizes that centrifugal force increases the amount of liquid that can be electrostatically atomized in a given period of time, by presenting it to the field in a uniform, thin, replenished film.

Defendants are accordingly making use of the matters claimed in the claims in suit of the Starkey 2,685,536 and 2,794,417, the Crouse 2,893,893, and the Ransburg 2,893,894 patents, and are liable for infringement of such claims. It matters not that they may not be using all that is dis-

[66] PX 245; transcript, pages 3621-3631.

closed and claimed, or that they may be making an impaired use (as in the M-50 operation).

Even under defendants' theory, atomization occurs at the point of greatest field intensity.

If defendants were sincere in their professions, they would not charge the rotating heads, but would create a field adjacent to, or away from, the atomizing head.

[1, 2] The inventive ideas of plaintiff have been appropriated; supplementation or modification, even if an improvement, will not avoid infringement, Specialty Equipment & Machinery Corp. v. Zell Motor Car Co., 4 Cir. 1952, 193 F.2d 515, 519; nor will an impairment, Weiss v. R. Hoe & Co., 2 Cir. 1940, 109 F.2d 722, 726; Matthews v. Allen, 4 Cir. 1950, 182 F.2d 824, 827-828; Eames v. Andrews, 1887, 122 U.S. 40, 70, 7 S.Ct. 1073, 30 L.Ed. 1964; Hoeltke v. C. M. Kemp, 4 Cir. 1936, 80 F.2d 912, 941. "If the infringing device performs the same function as the patented device, it is immaterial that it also performs some other function. It is still * * * an appropriation of the patented invention." Chesapeake & Ohio Ry. Co. v. Kaltenbach, 4 Cir. 1939, 95 F.2d 801, 804.

Defendants' Model 12 apparatus is not charged with infringing the '602 patent.

Defendants concede[67] that if the '602 is valid, their Model 50 apparatus would infringe. The court has found the '602 patent to be valid, and therefore finds it infringed by defendants' Model 50 apparatus.

Defendants deny that the M-50 dual disc apparatus infringes the '602 patent, because "[A]ll of the claims except claims 8, 9, 11 and 15 are specifically limited to looped,

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[67] Defendants' Brief, page 78.

circular or arcuate conveyors."[68] (Note: the amended complaint alleges infringement of claims 1, 6-10, 12, 13, 15-21 so that the argument apparently concedes infringement of claims 8, 9 and 15). Defendants contend that the "two, straight-sided conveyors used in connection with the Model M-50 apparatus cannot conceivably infringe those claims."[69]

To refer to defendants' conveyor in connection with Ionic's M-50 apparatus as composed of "two, straight-sided conveyors" is misleading; they are two legs of a U-shaped conveyor. The conveyor shown in Sedlacsik, Jr. patent 2,894,485[70] are rectangles with rounded corners; the only places in which reference is made to the shape of the path to be traveled by the articles, refer to it as a "predetermined loop path"[71]; or " a U-shaped *portion* of a spray path"[72].

Moreover, the spray produced by the M-50 is annular, or radially expanding, as set forth in some of the claims of the '602 patent. The U-shaped loop retains most of the advantages of the circular loop. It uses beneficially the radially expanding spray, although perhaps not as efficiently as a truly circular loop. The court will not agree that a minor change in design, intended to take advantage of the inventive concept of the '602 patent, can avoid infringement, particularly when the change offers no justification other than an apparently conscious effort to depart from a true circle, and so avoid letter-perfect infringement.

The court finds that the M-50 apparatus infringes the '602 patent.

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[68] Ibid.
[69] Ibid.
[70] Figures 1 and 2.
[71] Column 8, line 24; column 10, line 57; column 13, line 39.
[72] Column 11, line 37; column 11, line 59, emphasis supplied.

**Damages.**

[3] Plaintiff seeks treble damages under 35 U.S.C. § 284, and reasonable attorney's fees under 35 U.S.C. § 285. A strong case for such allowances is made out by the showing that Ionic, like its predecessor, was the jackal following the hunter; that before any accused devices were sold, the Sedlacsiks had knowledge of the '536 and '417 patents; that up to and into the trial they continued to give notice of additional prior art and alleged prior uses; that higher and higher head speeds were claimed as the defense to infringement developed; and that the defense that the paint does not have time to be charged on the head, was not developed, or at least disclosed, until the trial had begun.

In reply, defendants point out that when suit was begun, only the Starkey '536 and '417 and the Ransburg '472 patents had issued; that plaintiff dropped its charge of infringement of the Ransburg '472; and that after the Simmons '602 patent issued, Ionic ceased selling the Model 50.

The question is a close one, but the court does not feel that treble damages or attorneys' fees should be allowed.

[4-8] The court finds as facts, and rules as a matter of law, that:

1. Patents 2,685,536, 2,794,417, 2,893,893, 2,893,894 and Re. 24,602, are valid.

2. Defendants have infringed claims 1-11 of 2,685,536; claims 3-4 of 2,794,417; claims 1, 2, 3, 5, 6, 8-10 of 2,893,893; claims 1-8 of 2,893,894; and claims 1, 6-10, 12, 13, 15-21 of Re 24,602.

3. Defendants' counterclaims should be dismissed.

The foregoing opinion embodies the court's finding of facts and conclusions of law under F.R.C.P. 52(a), 28

U.S.C.A., whether or not so expressly characterized; and incorporates such portions of the proposed findings of fact and conclusions of law, submitted by the parties, as the court deems appropriate and necessary.

Let the parties submit an appropriate decree within ten days.

## Appendix A.

August 3, 1954 W. A. Starkey, et al. 2,685,536.
Method for Electrostatically Coating Articles.
Filed September 29, 1944.

### Typical Claims.

4. A method of electrostatically distributing liquid as a coating on an article, comprising the steps of supplying liquid coating material at a controlled rate to an atomizing zone located in spaced relation to the article, establishing said liquid as an electrode of an electrostatic field, atomizing finely divided discrete spray particles from the liquid at the atomizing zone, and dispersing such particles widely in at least two mutually perpendicular directions and depositing them still so dispersed and while still in liquid state as discrete spray particles on the article to form a finished coating thereon, the distance between the atomizing zone and the article being great enough to permit said dispersion of the particles as they proceed toward the article, the atmosphere in the region between the atomizing zone and the article being quiescent whereby electrostatic forces will be the predominant factor determining the paths respectively followed by the atomized particles as they move toward deposition, and moving said article relative to said atomizing zone so as to effect a substantial displacement of the article surface transverse to the general direction of the lines of force of the field during particle

deposition to cause such lines of force to sweep such article surface.

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10. The method of electrostatically distributing liquid as a coating on an article, comprising the steps of moving the article past and in spaced relation to a zone of atomization, feeding liquid coating material in a relatively narrow stream, spreading said stream to form it into a body of liquid coating material having an extent many times the maximum cross-sectional dimension of said stream, maintaining at such zone of atomization the body of liquid coating material with said body having a plurality of closely spaced aligned exposed termini of relatively small area, establishing between the exposed termini of the coating material and the article moving past it an electrostatic field of sufficient strength that it both electrostatically atomizes small particles of coating material from such exposed termini and electrostatically deposits them still in the form of discrete spray particles while still in liquid state for distribution into a continuous finished coating upon the article as it moves past the zone of atomization, and continuously and at a controlled rate maintaining said stream to supply coating material to said body to replace the coating material atomized therefrom by the action of the electrostatic field, said atomization and deposition both being effected in quiescent air, the direction of movement of said article relative to said body of coating material being such as to effect a substantial displacement of the article surface transverse to the general direction of the lines of force of the field during particle deposition to cause such lines of force to sweep such article surface, the spacing of said body of coating material from the article being great enough that the atomized particles will disperse under the action of the field as they move toward the article until they are distributed over and deposited

onto a portion of the article surface having an area many times the area of the exposed termini.

June 4, 1957 W. A. Starkey, et al. 2,794,417.
Apparatus for Electrostatically Coating Articles.
Original filed September 29, 1944.

**Typical Claims.**

3. Apparatus for electrostatically coating an article with a liquid coating material, comprising a conveyor for moving the article over a predetermined path, a single-fluid atomizing head provided with a liquid supporting, flow-guiding surface having a terminus adjacent which liquid coating material is to be atomized, means for supplying liquid coating material at a controlled rate to said surface at a point spaced rearwardly from said terminus for flow as an exposed body over the surface to said terminus for atomization therefrom, and means including a high-voltage source having its opposite terminals electrically connected to the article on the conveyor and the liquid at said terminus for establishing an electrostatic field therebetween capable of atomizing the liquid from said exposed body at said terminus in the form of a spray and electrostatically depositing the spray on the article while still in liquid state, said head and conveyor being spaced apart by a distance great enough to permit the atomized liquid leaving said member to be widely dispersed.

4. Apparatus for electrostatically spray-coating an article, comprising an atomizing head, means for feeding liquid coating material to said head, means including said feeding means for distributing coating material to an extended atomizing zone where it is atomized from a plurality of spaced points, said points being sufficiently close together to permit the coating material to bridge the spaces there-

between, a support for supporting an article to be coated in spaced relation to said atomizing zone, and means including a high-voltage source for creating over the surface of the article on said support an electrostatic field capable of atomizing the coating material into finely divided, electrically charged particles and electrostatically depositing particles atomized from said atomizing zone on the article while still in liquid state, said atomizing head and support being so relatively disposed as to provide between the article and the atomizing zone a spacing great enough to permit substantial dispersion of the atomized particles by the electrostatic forces of the field.

July 7, 1959 W. W. Crouse, 2,893,893.

Method and Apparatus for Electrostatic Coating.

Filed January 31, 1950 [Continuation in part of abandoned application filed March 5, 1948].

**Typical Claims.**

2. A method of electrostatically distributing liquid as a coating on an article, comprising the steps of flowing a stream of liquid coating material from a supply orifice and positively deforming it into a thin film advanced without subdivision from the orifice to an atomizing zone to provide a thin film edge substantially spaced from the article and having an extent many times its thickness, creating between said film edge and said article an electrostatic field of sufficient strength to form and affect the spacing of cusps at said edge and to electrostatically atomize finely divided discrete particles of liquid as a spray from the edge of said film at said zone, supplying said film with liquid at a controlled rate to replace that so atomized, and electrostatically dispersing said particles and depositing them still as discrete liquid spray particles on the article, the distance between the article and the atomizing

zone being great enough to permit substantial dispersion of the liquid spray particles as they proceed toward the article, the atmosphere at the article being quiescent whereby electrostatic forces will effect deposition on the article of a substantial number of particles which otherwise would not have been deposited thereon.

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9. Apparatus for electrostatically spray coating the surface of an article with liquid atomized from an extended atomizing zone, comprising an atomizing head, means for delivering liquid coating material at a controlled rate from a source of supply to said head, said head including means for forming said liquid into a thin supported film and for providing said film with a substantially uniform leading edge extending along the atomizing zone, means for establishing between said film-edge and said article an electrostatic field of sufficient strength to draw the liquid of the film-edge beyond its support and form said film-edge into a series of spaced cusps, to electrostatically atomize said liquid from said cusps into a spray of finely divided discrete particles, and to disperse and deposit said particles on the article surface while still in liquid state, and means for positioning the article surface at a distance from the atomizing zone to permit substantial dispersion of liquid spray particles through a quiescent atmosphere as they proceed toward the article surface.

July 7, 1959 E. M. Ransburg, 2,893,894.

Method and Apparatus for Electrostatically Coating.

Original filed February 13, 1950 [Continuation of Serial No. 143,994, February 13, 1950].

## Typical Claims.

1. In a method of electrostatically spray coating the surface of an article with liquid atomized from an annular atomizing zone, the steps of flowing liquid coating material at a controlled rate from a source of supply to a rotatable head, forming it into a thin film supported on said head and advancing said supported film toward said atomizing zone by rotating the head, said film having a uniform edge of an extent many times its thickness, establishing between said film-edge and said article an electrostatic field of sufficient strength to form said film-edge into a series of spaced cusps and to electrostatically atomize finely divided discrete particles of liquid as a spray from said cusps, and electrostatically dispersing and depositing said particles on the article surface while still in liquid state, said article surface being in a substantially quiescent atmosphere and at a distance from said atomizing zone sufficient to permit substantial dispersion of the liquid spray particles as they proceed toward the article.

* * * * * *

7. Apparatus for electrostatically spray coating the surface of an article with liquid atomized from an annular atomizing zone, comprising an atomizing head mounted for rotation about the axis of said atomizing zone, means for feeding liquid coating material at a controlled rate from a source of supply to said head, means for rotating said head, said head including means effective in rotation of the head for forming said liquid into a thin supported film and for providing said film with a substantially uniform leading edge at the atomizing zone, means for establishing between said film-edge and said article an electrostatic field of sufficient strength to draw the liquid of the film-edge beyond its support and form said film-edge into a series of spaced cusps, to electrostatically atomize said

liquid from said cusps into a spray of finely divided discrete particles, and to disperse and deposit said particles on the article surface while still in liquid state, and means for maintaining said article surface in a substantially quiescent atmosphere and at a distance from said atomizing zone sufficient to permit substantial dispersion of the liquid spray particles as they proceed toward the article.

February 17, 1959 C. C. Simmons, Re. 24,602.

Electrostatic Method and Apparatus For Spray Coating of Articles.

Original filed March 5, 1952.

**Typical Claims.**

8. Apparatus for electrostatically coating a plurality of articles comprising a rotatably mounted disk, means for supplying liquid coating material to the disk inwardly of the edge thereof, means for rotating the disk to move the material radially to an atomizing zone adjacent the edge of the disk for atomization and centrifugal projection from said atomizing zone in the form of finely divided particles, means for bodily transporting articles in path portions on opposite sides of the disk and in the plane thereof, and means for creating an electrostatic charge differential between the atomized particles and the article.

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13. Apparatus for coating a plurality of articles from exteriorly thereof, comprising: a rotatably mounted atomizing device having a circular edge; means for supplying liquid coating material to a surface of the device; means for rotating the device to move the coating material fed thereto to the edge for atomization therefrom as a spray expanding radially from the axis of rotation of the device; a conveyor for bodily transporting said articles successively within the spray along a curved path concave toward said

atomizing device and through at least a substantial portion of the spray; means for creating an electrostatic charge differential between the spray particles and the articles electrostatically to deposit the particles on the articles; and means for reciprocating the atomizing device parallel to its axis of rotation during the coating.

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15. A method for providing a relatively wide coverage of an annular spray pattern in an electrostatic coating system, comprising: projecting spray particles radially in an expanding disc-like pattern; carrying articles to be coated in a path having portions on generally opposite sides of the axis of the pattern and in the plane of the spray particle projection; said path portions being of greater length than the transverse extent of the spray pattern; and creating an electrostatic charge differential between the spray particles and the articles electrostatically to deposit the particles on the articles.

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20. A method for electrostatically spray coating a plurality of articles from exteriorly thereof comprising, providing an electrode, bodily and sequentially transporting articles in a looped path to simultaneously position a plurality of such articles around and substantially equidistant from said electrode, creating an electrostatic field extending between said electrode and said articles, and introducing atomized liquid coating material particles into said field for movement from adjacent said electrode to the articles to be electrostatically deposited thereon while maintaining the articles around said electrode, simultaneously to apply coating material to said articles.

IN THE

# UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF MARYLAND

| | |
|---|---|
| **RANSBURG ELECTRO-COATING CORPORATION, a corporation,** *Plaintiff,* **v. PROCTOR ELECTRIC COMPANY, INC., a corporation, and IONIC ELECTROSTATIC CORPORATION, a corporation,** *Defendants.* | **Civil Action No. 10181** |

## INTERLOCUTORY JUDGMENT

This cause having been submitted to the court, without intervention of a jury, for trial of all issues except the measure of damages, previously deferred by stipulation of the parties; the parties having submitted their proposed findings of fact, conclusions of law and post-trial briefs; the court having considered the pleadings, the opening statements of counsel, the evidence received at the trial, the proposed findings of fact, conclusions of law and briefs and arguments of counsel; the court having witnessed *inter partes* demonstrations of the processes and apparatus of the patents in suit, of certain of the prior art, and having witnessed demonstrations of the processes and apparatus as follows: (a) the operation of the equipment designated "Model 50" manufactured and sold by defendant, Ionic, to defendant, Proctor, and used by defendant, Proctor, at its Baltimore plant, and (b) the operation of the equipment designated "Model 12" and "Model M-50", respectively, manufactured and sold by defendant, Ionic; and the court having on March 15, 1962, filed herein, pur-

suant to Rule 52 of the Federal Rules of Civil Procedure, its opinion embodying its findings of fact and conclusions of law:

Upon the aforesaid findings of fact and conclusions of law, It is Hereby Adjudged and Decreed That:

1. This court has jurisdiction of the parties and the action and the counterclaim, and the provisions of venue are satisfied.

2. Plaintiff is the owner of United States Letters patent No. 2,685,536, No. 2,794,417, No. 2,893,893, No. 2,893,894, and No. Re. 24,602, and has the right to enforce said Letters Patent against the defendants, and each of them, and the plaintiff in no wise, is barred or estopped, by law or equity, from so doing.

3. United States Letters Patent No. 2,685,536 entitled: "Method for Electrostatically Coating A. icles," as to claims 1 to 11, inclusive, is in all respects, valid.

4. Defendant, Proctor Electric Company, Inc., hereinafter called "Proctor" has infrined claims 1 to 11, inclusive, of the aforesaid patent by the operation of apparatus designated as "Model 50".

5. Defendant, Ionic Electrostatic Corporation, hereinafter called "Ionic", has infringed claims 1 to 11, inclusive, of the aforesaid patent by using the process claimed therein, and has contributed to the infringement thereof by selling apparatus designated as "Model 50" to Proctor, and "Model 50," "Model M-50," and "Model 12" to others.

6. United States Letters Patent No. 2,794,417 entitled: "Apparatus for Electrostatically Coating Articles," as to claims 3 and 4 is, in all respects, valid.

7. Defendant, Proctor, has infringed claims 3 and 4 of

the aforesaid patent by using apparatus designated as "Model 50."

8. Defendant, Ionic, has infringed claims 3 and 4 of the aforesaid patent by making, selling and using the apparatus designated as "Model 50," "Model M-50," and "Model 12," and has contributed to the infringement thereof by selling apparatus designated as "Model 50" to Proctor, and "Model 50," "Model M-50," and "Model 12," to others.

9. United States Letters Patent No. 2,893,893 entitled "Method and Apparatus for Electrostatic Coating," as to claims 1, 2, 3, 5, 6, 8, 9 and 10 is, in all respects, valid.

10. Defendant, Proctor, has infringed claims 1, 2, 3, 5, 6, 8, 9 and 10 of the aforesaid patent by using and operating apparatus designated as "Model 50."

11. Defendant, Ionic, has infringed claims 1, 2, 3, 5, 6, 8, 9 and 10 of the aforesaid patent by using the process claimed therein and by making, selling and using the apparatus designated as "Model 50," "Model M-50," and "Model 12," and has contributed to the infringement of said patent by selling apparatus designated as "Model 50" to Proctor, and "Model 50," "Model M-50," and "Model 12" to others.

12. United States Letters Patent No. 2,893,894 entitled: "Method and Apparatus for Electrostatically Coating," as to claims 1 to 8, inclusive, is, in all respects, valid.

13. Defendant, Proctor, has infringed claims 1 to 8, inclusive, of the aforesaid patent by using and operating apparatus designated as "Model 50."

14. Defendant, Ionic, has infringed claims 1 to 8, inclusive, of the aforesaid patent by using the process claimed therein and by making, selling and using the appartus designated as "Model 50," "Model M-50," and "Model 12,", and has contributed to the infringement of said patent by

selling apparatus designated as "Model 50" to Proctor, and "Model 50," "Model M-50," and "Model 12" to others.

15. United States Letters Patent No. Re. 24,602 entitled: "Electrostatic Method and Apparatus For Spray Coating of Articles," as to claims 1, 6 to 10, inclusive, 12, 13, and 15 to 21, inclusive, is, in all respects, valid.

16. Defendant, Proctor, has infringed claims 1, 6 to 10, inclusive, 12, 13, and 15 to 21, inclusive, of the aforesaid patent by using and operating apparatus designated as "Model 50."

17. Defendant, Ionic has infringed claims 1, 6 to 10, inclusive, 12, 13, and 15 to 21, inclusive, of the aforesaid patent by using the process claimed therein and by making, selling and using the apparatus designated as "Model 50," "Model M-50," and "Model 12," and has contributed to the infringement of said patent by selling apparatus designated as "Model 50" to Proctor, and "Model 50," "Model M-50," and "Model 12" to others.

18. Defendant, Proctor, including its officers, agents, servants, employees and attorneys, and those persons in active concert or participation with them, and each of them, is enjoined from:

(a) Making, using or selling the appartus described, respectively, in this cause as "Model 12," "Model 50" and "Model M-50," or equivalents thereof, duing the life of any of United States Letters Patent No. 2,685,536, No. 2,794,417, No. 2,893,893 and No. 2,893,894, and making, using or selling the apparatus described, respectively, in this cause as "Model 50" and "Model M-50," or equivalents thereof, during the life of United States Letters Patent No. Re. 24,602.

(b) Practicing the electrostatic spray coating process which is performed in the use of the apparatus described, respectively, in this cause as "Model 12," "Model 50" and

"Model M-50" or equivalents, including any process, (1) in which liquid coating material is advanced in a thin film to the edge of an atomizing head, an electrical potential is created at said edge by applying voltage to said atomizing head, said electrical potential being sufficient to create an electrostatic field between said atomizing head and the objects to be coated of sufficient strength to atomize, disperse and deposit the liquid coating material on the articles to be coated; or, (2) any process in which liquid coating material is advanced in a thin film to the edge of an atomizing head, an electrical potential is created at said edge by applying voltage to said atomizing head, said electrical potential being sufficient to create an electrostatic field between said atomizing head and the objects to be coated of sufficient strength to disperse and deposit the liquid coating material on articles to be coated and atomizing liquid coating material at the point of highest concentration of the lines of force in the electrostatic field, during the life of any United States Letters Patent No. 2,685,536, No. 2,794,417, No. 2,893,893 and No. 2,893,894, and practicing the electrostatic spray coating process which is performed in the use of apparatus described respectively in this cause as "Model 50" and "Model M-50" or equivalents, including any process which involves placing said atomizing head within a looped, circular or arcuate conveyor or equivalent thereof such that all or substantially all of a radially expanding spray from said head is utilized in coating articles, during the life of United States Letters Patent No. Re. 24,602.

(c) Actively inducing others to perform, or contributing to the performance by others of, any of the acts enjoined in subparagraphs (a) and (b) immediately above.

19. Defendant, Ionic, including its officers, agents, servants, employees and attorneys, and those persons in active

concert or participation with them, and each of them, is enjoined from:

(a) Making, using or selling the apparatus described, respectively, in this cause as "Model 12," "Model 50" and "Model M-50," or equivalents thereof, during the life of any of United States Letters Patent No. 2,685,536, No. 2,794,417, No. 2,893,893 and No. 2,893,894, and making, using or selling the apparatus described, respectively, in this cause as "Model 50" and "Model M-50," or equivalents thereof, during the life of United States Letters Patent No. Re. 24,602.

(b) Practicing the electrostatic spray coating process which is performed in the use of the apparatus described, respectively, in this cause as "Model 12," "Model 50," and "Model M-50" or equivalents, including any process, (1) in which liquid coating material is advanced in a thin film to the edge of an atomizing head, an electrical potential is created at said edge by applying voltage to said atomizing head, said electrical potential being sufficient to create an electrostatic field between said atomizing head and the objects to be coated of sufficient strength to atomize, disperse and deposit the liquid coating material on the articles to be coated; or, (2) any process in which liquid coating material is advanced in a thin film to the edge of an atomizing head, an electrical potential is created at said edge by applying voltage to said atomizing head, said electrical potential being sufficient to create an electrostatic field between said atomizing head and the objects to be coated of sufficient strength to disperse and deposit the liquid coating material on articles to be coated and atomizing liquid coating material at the point of highest concentration of the lines of force in the electrostatic field, during the life of any United States Letters Patent No. 2,685,536, No. 2,794,417, No. 2,893,893 and No. 2,893,894, and practicing

the electrostatic spray coating process which is performed in the use of apparatus described respectively in this cause as "Model 50" and "Model M-50" or equivalents, including any process which involves placing said atomizing head within a looped, circular or arcuate conveyor or equivalent thereof such that all or substantially all of a radially expanding spray from said head is utilized in coating articles, during the life of United States Letters Patent No. Re. 24,602.

(c) Actively inducing others to perform, or contributing to the performance by others of, any of the acts enjoined in subparagraphs (a) and (b) immediately above.

20. Plaintiff is estopped from asserting against defendants, or either of them, or their privies, any claim that any device of defendants, or either of them, in existence on March 15, 1960, infringes any one or more of the claims of United States Letters Patent No. 2,658,472.

21. The plaintiff recover from the defendants damages for infringment of United States Letters Patent No. 2,685,536, No. 2,794,417, No. 2,893,893, No. 2,893,894 and No. Re. 24,602, pursuant to Title 35, U.S.C. Section 284 by reason of defendant, Proctor's, use in the United States, since the respective dates of issue of the aforesaid patents, of one or more of the aforesaid "Model 50" coating devices.

22. The plaintiff recover from defendant, Ionic, damages for infringement of United States Letters Patent No. 2,685,536, No. 2,794,417, No. 2,893,893, No. 2,893,894 and No. Re. 24,602, pursuant to Title 35 U.S.C. Section 284, by reason of defendant, Ionic, making, selling or using in the United States, since the respective dates of issue of the aforesaid patents, of one or more of the aforesaid "Model 12," "Model 50" and "Model M-50" coating devices and their equivalents.

23. The court retains jurisdiction of the action as to the amount of damages, but the appointment of a special master to ascertain and report to the court the amount of damages is deferred until after the time for appeal has expired, if no appeal is taken, or until after the return of the mandate from the Court of Appeals, if an appeal should be taken.

24. Defendants' counterclaims are hereby dismissed.

25. Plaintiff shall recover from defendants its costs which are to be taxed by the Clerk pursuant to the rules of this Court.

/s/ Judge Watkins
Judge, United States District Court
for the District of Maryland

Dated: May 7, 1962.

**RANSBURG ELECTRO-COATING CORP.,**
**Appellee,**

**v.**

**PROCTOR ELECTRIC COMPANY, Inc.,**
**AND IONIC ELECTROSTATIC CORPORATION,**
**Appellants.**

**No. 8844.**

United States Court of Appeals
Fourth Circuit.

Argued March 27, 1963.
Decided May 14, 1963.

HAYNSWORTH, Circuit Judge.

In this appeal of a patent case, the defendant principally asserts invalidity of the plaintiff's patents in light of the prior art, file wrapper estoppel against construction of the patent claims so as to cover the accused devices and methods for electrostatic spray painting and of double patenting arising out of the voluntary separation of method and apparatus claims, with the resultant issue of two separate patents, one of which includes method claims, the other of which includes apparatus claims.

After the trial in the Court below, the District Judge prepared and filed a very comprehe sive opinion,[1] in which he fully deals with the principal contentions of the defendant on this appeal. Nothing need be added here to the very complete and adequate discussion of those issues by the District Judge, for this Court reaches the same conclusion for the reasons stated by the District Judge.

On appeal, the defendant tenders two issues which were not raised below. We have considered them, despite the

[1] Ransburg Electro-Coating Corp. v. Proctor Electric Co., D.Md., 203 F.Supp. 235.

fact that they are tendered here for the first time, but we find no merit in them.

The first of the two contentions is that Ransburg Patent No. 2,893,894, one of the five principal patents in suit, is void for double patenting over Ransburg Patent No. 2,658,472, a patent which is not in suit, though owned by the plaintiff. The '472 patent was directed principally to an apparatus for delivery of paint to an extended edge of an atomizing head with improved uniformity with resultant improvement in the uniformity of distribution of the spray. The extended head of the '472 patent could be straight or circular, and, if circular, either rotating or stationary. The patentee explained in '472 that he was claiming the rotating head as such in a separate application, upon which the '894 patent ultimately issued. The '894 patent is principally directed to the electrostatic formation of small cusps in a thin film of coating material and the electrostatic atomization of liquid drawn from the spaced cusps. The principal advance of the '894 patent, was the elimination of mechanical means for the formation of such cusps, which, theretofore, had been thought essential in electrostatic spray coating.

[1] We thus find that the two patents deal with different subject matter, and '472 having been made junior to '894, we find no basis for the belated claim of double patenting.

[2] The other belated contention is that the '894 patent is invalid because of the plaintiff's own use of its method and apparatus during a period which the defendant contends was a hiatus in the applications. The '894 invention was originally claimed in Serial No. 57,259, of which later Application Serial No. 143,994 was a continuation in part. The Examiner rejected the application and the Board of Appeals of the Patent Office affirmed on October 4, 1956.

Thereupon, the plaintiff promptly brought a civil action seeking an allowance of his application. Before that civil action came on for trial, however, the patent office decided to allow claims on the basis of the disclosure in Application Serial No. 143,994. Thereupon, the civil action was dismissed by stipulation without prejudice to the allowance of patent claims and the '894 patent issued.

The defendant contends that when the civil action was dismissed, there occurred a technical abandonment of the application as of the earlier date six months after the Appeals Board originally affirmed the Examiner's rejection of the application.

The contention that continuity of the application was broken during pendency of the civil action finds some support in such old decisions as that of the patent Board of Appeals in Drew v. Van Cleef, (P.O.Bd.App.) 48 U.S.P.Q. 643, 645. In 1948, however, the Commissioner of Patents revised the practice, and by order published in the Official Gazette on September 28, 1948, provided that an application would not be considered abandoned as of a date prior to the date of dismissal of a civil action, if abandonment is predicated upon the dismissal alone. This appears to have been the purpose of Section 120 of the 1952 Patent Act, which provides, in effect, that an application has the effective date of a previous application filed by the same inventor, if "filed before the patenting or abandonment of or termination of proceedings" on the earlier application. Certainly the civil action in which the plaintiff sought allowance of its claims on the basis of his Application Serial No. 143,994, having been promptly and timely filed, was a "proceeding" on that application, and we cannot under the statute hold that the application was abandoned prior to the date of the voluntary dismissal, without prejudice, of the civil action.

We conclude that the District Court properly found the plaintiff's patents valid and infringed. We, therefore, affirm the judgment below and remand the case for the assessment of the damages, and for such further proceedings as may be appropriate.

Affirmed.

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## DECREE

### UNITED STATES COURT OF APPEALS

FOR THE FOURTH CIRCUIT

No. 8844

**RANSBURG ELECTRO-COATING CORP.,**

*Appellee,*

VS.

**PROCTOR ELECTRIC COMPANY, INC., AND IONIC ELECTROSTATIC CORPORATION,**

*Appellants.*

Appeal from the United States District Court for the District of Maryland.

This cause came on to be heard on the record from the United States District Court for the District of Maryland, and was argued by counsel.

On consideration whereof, It is now here ordered, adjudged and decreed by this Court that the decree of the said District Court appealed from, in this cause, be, and the same is hereby, affirmed with costs; and that this cause be, and the same is hereby, remanded to the United States District Court for the District of Maryland, at Baltimore, for the assessment of the damages and for such further

proceedings as may be appropriate in accordance with the opinion of the Court filed herein.

FILED
May 14 1963
R. M. F. WILLIAMS, JR.
Clerk

CLEMENT F. HAYNSWORTH, JR.
United States Circuit Judge.
HERBERT S. BOREMAN
United States Circuit Judge.
L. RICHARDSON PREYER
United States District Judge.

A true copy,
Teste:
RICHARD M. F. WILLIAMS, JR., Clerk
U. S. Court of Appeals for the
Fourth Circuit.
By MARGARET M. WALTON,
Deputy Clerk

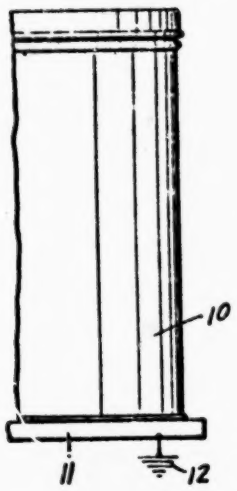
COSTS OF Appellee:
Cost of printing brief
and appendix at not exceeding
$3.00 per printed page.
Filed 17 June, 1963

Aug. 3, 1954 W. A. STARKEY ET AL 2,685,536

METHOD FOR ELECTROSTATICALLY COATING ARTICLES

Filed Sept. 29, 1944 2 Sheets-Sheet 1

FIG. 1



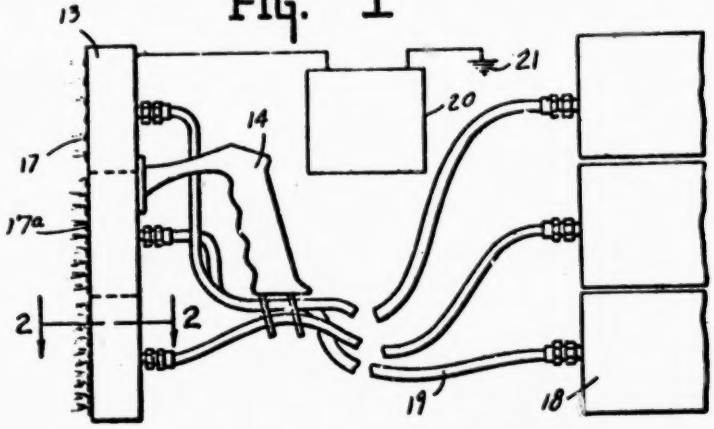




FIG. 2

FIG. 3

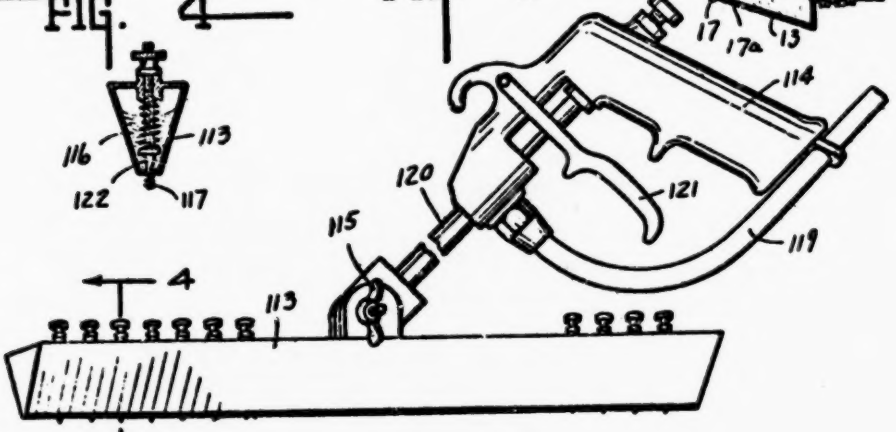



FIG. 4




FIG. 5

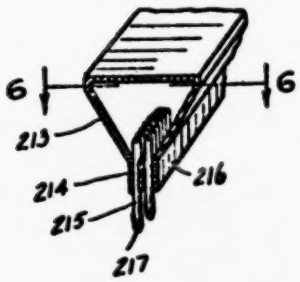
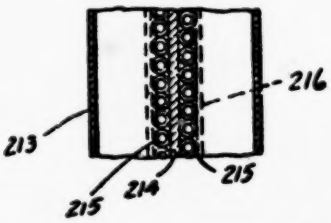



FIG. 6

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Aug. 3, 1954 W. A. STARKEY ET AL 2,685,536

METHOD FOR ELECTROSTATICALLY COATING ARTICLES

Filed Sept. 29, 1944 2 Sheets-Sheet 2

FIG. 7

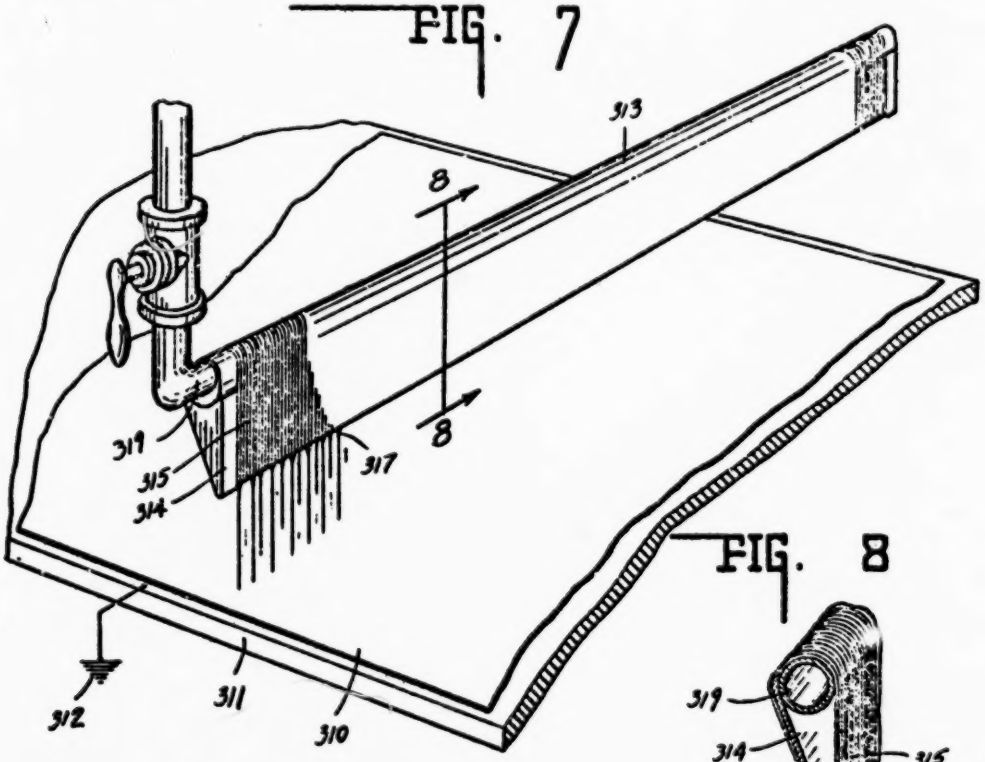



FIG. 8

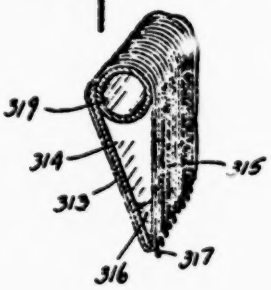
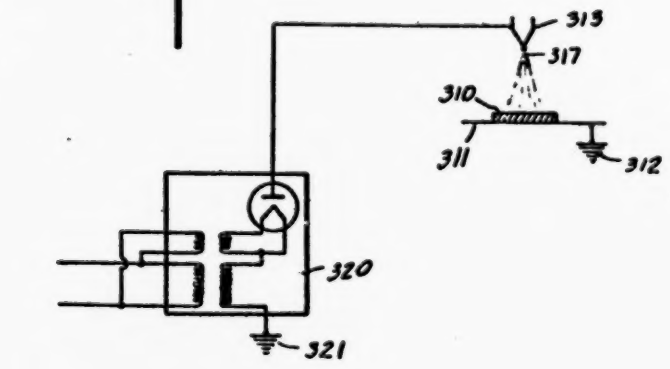



FIG. 9

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ATTORNEYS.

Patented Aug. 3, 1954 2,685,536

# UNITED STATES PATENT OFFICE

2,685,536

## METHOD FOR ELECTROSTATICALLY COATING ARTICLES

William A. Starkey, Zionsville, and Edwin M. Ransburg, Indianapolis, Ind., assignors, by mesne assignments, to Ransburg Electro-Coating Corp., Indianapolis, Ind., a corporation of Indiana

Application September 29, 1944, Serial No. 556,390

11 Claims. (Cl. 117—93)

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This invention relates to a method and apparatus for electrostatically coating articles with a liquid coating material, such as paint, lacquer, ink, wax and the like. Such articles to be coated may be of either conducting or non-conducting material, may be structural in character or comprise fabric or paper sheets.

In respect to the method of electrostatically coating articles by discharging a spray of coating material from an air operated or air atomizing spray gun reference may be made to such prior patents as Pugh, No. 1,855,859, issued April 26, 1932, for "Method and Apparatus for Coating Articles," and Ransburg and Green, Nos. 2,247,963 and 2,334,648, issued July 1, 1941, and November 16, 1943, for "Apparatus for Spray Coating Articles" and "Method of Spray Coating Articles," respectively.

However, in the use of spray guns or the like many disadvantages develop in that the air operated spray gun is limited to a comparatively small field of dispersion, but more important it causes the coating material to be discharged in non-uniform sized particles, and in variable patterns. Thus, there is an uneven dispersion of the coating particles over the surface to be coated due to the inertia generated in the discharge, causing the larger particles to travel further in the field than the more finely divided particles. In some arrangements, depending upon the direction of the discharge, a variable pattern of spray is created and reproduced on the surface to be coated, the heavier coating particles being caused to impinge over one area and the more finely divided particles over another area. By reason of such variance, it has been found necessary in practice under certain conditions of coating to arrange a sizeable battery of spray guns with particular regard to their variable patterns of coating application so that the several guns complement each other to even out the pattern as a battery.

It is the purpose of this invention to meet this problem of coating articles in an electrostatic field by eliminating the use of such spray guns and employ in place thereof a new method and apparatus for supplying the coating material for electrostatic precipitation upon the surface to be coated. This is accomplished by providing in the field a series or plurality of small inert droplets of coating material and establishing such electrostatic force in the field as to develop and transmit finely divided particles of coating material from said droplets to the surface of the article to be coated. In describing as "inert"

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the drops or droplets from which atomization takes place, it is our purpose to indicate that during the coating process each drop is supported on the head as above described, and that while the drop may be continuously giving off liquid for atomization, replacement enables its identity as a supported body of liquid to be maintained.

Such method and apparatus has several important advantages over the spray gun arrangements heretofore employed. The coating material may be introduced into the electrostatic field by an applicator head having a series of orifices through which the material may ooze in the form of inert droplets. Such applicator head may be substantially coextensive with the surface to be coated and thereby take the place of a battery of spray guns as heretofore employed. The droplets will be developed into finely divided particles by the electrostatic force so that all particles will be transmitted or precipitated upon the surface to be coated uniformly over the entire surface.

A feature of the invention, as above described, resides in the applicator head including formation of the discharge orifices therein and the control of the rate of discharge of the material to form the inert droplets at approximately the rate of their electrostatic discharge. Thus, depending upon the viscosity and other characteristics of the material, the control of the applicator head will be such as to permit discharge of just the right quantity and size of the droplets to effect the greatest efficiency in coating a surface.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims:

Fig. 1 is a diagrammatical illustration showing one arrangement of applicator in respect to the article to be coated. Fig. 2 is a section taken on the line 2—2 of Fig. 1. Fig. 3 is a perspective view of a modified form of applicator with a control handle associated therewith. Fig. 4 is a section taken on the line 4—4 of Fig. 3. Fig. 5 is a perspective sectional view showing a portion of a further modification of the applicator head. Fig. 6 is the same as Fig. 5, taken on the line 6—6 thereof. Fig. 7 is a perspective view of a further modification of the applicator head in association with the surface to be coated. Fig. 8 is a section taken on the line 8—8 of Fig. 7. Fig. 9 is a diagrammatical illustration of the circuit and one of the arrangements of the applicator head relative to the article to be coated.

The invention is illustrated by one modification

thereof in Figs. 1 and 2 wherein there is shown an article 10 to be coated mounted or carried upon a suitable support or conveyor 11 which is grounded at 12. An applicator head 13 is provided which is preferably substantially co-extensive with the surface to be coated. Said applicator head may be fixedly or adjustably mounted on a suitable support, or hand manipulated by a handle 14. The applicator head, as indicated in Fig. 2, is V-shape in cross section and along its reduced discharge edge 17a it is provided with a series of orifices 15 through which the coating material indicated at 16 may be oozed out in the form of droplets 17. The applicator head may be connected with a source of supply of coating material by a flexible tube, there being herein illustrated three compartments in the head, each connected with an individual source of supply 18 by a tube 19. The discharge edge 17a has an extent many times the maximum cross-sectional dimension of the passageways provided by the tubes 19. Sufficient pressure will be created in the containers forming the source of supply 18 for maintaining the material 16 in the head under just the proper pressure to cause the droplets to ooze therefrom as they are dispersed by the applied electrostatic force.

As illustrated, the applicator head is connected to a source of high voltage indicated at 20 through one terminal thereof, the other terminal of said source being grounded at 21 and through ground connected with an article 10 to be coated. Accordingly, the space or field between the applicator head and articel 10 is electrostatically charged by reason of the article being grounded and the applicator head being at high potential. The effect thereof is to cause an electrical force to act on the droplets 17, causing them to be broken up into finely divided or minute particles of coating material, such as to be attracted to the grounded article for deposition thereon. Thus, the grounded article may be referred to as a collecting electrode of one potential with the applicator head serving as a discharge electrode of a different potential. It is found that the electrostatic force set up in the field between the electrodes is such as to develop and transmit finely divided particles of the droplets 17 from one electrode to the other. In this connection it will be noted that as the droplets are caused to slowly ooze from the applicator head they are inactive or inert, but subject to being broken up into finely divided particles and distributed over the surface of the opposed electrode. The same action will take place wherein the applicator head may be grounded and the article directly connected with the source of high voltage and thus be charged at a high potential.

Another modification is illustrated in Figs. 3 and 4, wherein the applicator head 113 is adjustably supported by the handle 114 through a pivotal connection secured by thumb nut 115. The hose 119 leading from a source of coating material maintained under pressure, is connected with a valve operated conduit 120 controlled by the finger operated valve 121. Also, the droplets of coating material 117 may be controlled, depending upon the viscosity of the material indicated at 116 by a needle adjustment 122, which needle adjustably controls the orifice through which the material 116 is forced to provide the desired inert droplets.

Figs. 5 and 6 show a further modification of the applicator head indicated at 213. In this head the orifices through which the coating material flows are provided by a plate 214 clamped between opposed rows of needles 215. The needles are cylindrical so that the material will be caused to flow between them, the plate 214 and the clamping walls 216 so as to come out in the form of an inert droplet 217 of coating material.

In the modification of Figs. 7 and 8 there is illustrated a grounded surface 310 to be coated. This may be a continuously moving sheet of paper or any other article, it being understood that wherein such article or material is non-conducting, it is carried by and on a support or conveyor 311 of grounded conducting material. In this arrangement the applicator head 313 is supported across and above the surface to be coated, and coating material is fed thereto through the valve controlled pipe 314 leading from the source of such material. Said pipe extends through the head, having a series of orifices or openings therein through which the material may drip by gravity. Mounted on and connected to a source of high voltage through the pipe 319, there is a supporting shield 318 extending downwardly and terminating below the pipe to provide a frame for a wire wrapping 315. The coating material accumulates from the drippings into a pocket formed by the wire wrappings, as indicated at 316. The wire wrappings are slightly or sufficiently spaced to permit the coating material to slowly ooze or drip therebetween from the accumulation in the pocket indicated at 316 to form the droplets 317. In this instance the discharge or oozing of the material from the applicator head is aided by gravity, the droplets being thereupon broken up or developed into finely divided particles by the electrostatic force developed between the applicator head and the surface to be coated. Such finely divided particles will thereupon be dispersed by the electrostatic force over said surface and be applied to said surface. The applicator head can be grounded and the work maintained at high potential with equally efficient results.

By way of example, the arrangement of the overhead applicator of Fig. 7 is shown diagrammatically in Fig. 9, wherein the source of high voltage indicated at 320 has one terminal grounded at 321 and the other terminal connected with the applicator head 313 which is thereby maintained at high potential relative to the support or conveyor 311, which is connected with ground at 312.

As above pointed out, it is immaterial as to whether the article or the applicator head comprises the grounded electrode, since the electrostatic force set up therebetween will have the same effect on the droplets of coating material. Also, it is immaterial as to whether or not the article to be coated is of conducting or non-conducting material, and such article of non-conducting material is herein considered to be one of the electrodes wherein it is associated with or masks a grounded support of conducting material.

The invention claimed is:

1. A method of electrostatically distributing liquid as a coating on an article, comprising the steps of supporting liquid coating material in spaced relation to the surface of the article, forming a spray by electrostatically atomizing such coating material from a plurality of points so closely spaced as to form a substantially continuous extended atomizing zone, said points being distributed relative to the article surface, electrostatically dispersing the discrete coating-

material particles formed at each point of atomization, electrostatically depositing such dispersed discrete particles and while still in liquid state on the article surface to form a finished coating, and force feeding coating material to the points of atomization at a controlled substantially uniform rate to maintain thereat a supply of coating material for atomization, said atomization, dispersion and deposition all being effected in quiescent air by a single electrostatic field maintained between the supported coating material and the article surface, the distance between the article surface and the supported coating material being many times greater than the distance between adjacent ones of the points at which atomization of the coating material takes place.

2. In a method of electrostatically distributing liquid as a coating on a surface wherein liquid supplied at a controlled rate to a single-fluid atomizing head is atomized into discrete particles and such particles are dispersed to form a spray and deposited in dispersed condition while still in liquid state as a finished coating on a surface spaced a substantial distance from the head, the step of maintaining between the head and the article an electrostatic field which electrostatically effects said atomization, dispersion, and deposition.

3. A method of electrostatically distributing liquid as a coating on an article, comprising the steps of positioning a body of the liquid at an atomizing zone in spaced relation to the article, atomizing discrete particles of the liquid as a spray from said body at said zone, force feeding the body with liquid at a controlled rate to replace that so atomized, and dispersing said particles widely in at least two mutually perpendicular directions and electrostatically depositing them still so dispersed and as discrete spray-particles while still in liquid state as a finished coating on the article, the movement of the spray particles being through a quiescent atmosphere whereby the electrostatic forces effect deposition on an adjacent article surface of at least a majority of the spray particles which would have otherwise not deposited on the article surface, the distance between the article and the atomizing zone being great enough to permit said dispersion of the finely divided liquid spray particles as they proceed toward the article under the influence of electrostatic forces.

4. A method of electrostatically distributing liquid as a coating on an article, comprising the steps of supplying liquid coating material at a controlled rate to an atomizing zone located in spaced relation to the article, establishing said liquid as an electrode of an electrostatic field, atomizing finely divided discrete spray particles from the liquid at the atomizing zone, and dispersing such particles widely in at least two mutually perpendicular directions and depositing them still so dispersed and while still in liquid state as discrete spray particles on the article to form a finished coating thereon, the distance between the atomizing zone and the article being great enough to permit said dispersion of the particles as they proceed toward the article, the atmosphere in the region between the atomizing zone and the article being quiescent whereby electrostatic forces will be the predominant factor determining the paths respectively followed by the atomized particles as they move toward deposition, and moving said article relative to said atomizing zone so as to effect a substantial displacement of the article surface transverse to the general direction of the lines of force of the field during particle deposition to cause such lines of force to sweep such article surface.

5. In a method of electrostatically distributing liquid as a coating on an article wherein liquid coating material supplied at a controlled rate to a single-fluid atomizing head is force fed to and atomized into discrete particles from a plurality of points so closely spaced as to form a substantially continuous atomizing zone and such particles are dispersed and deposited in dispersed condition and while still in liquid state on an article spaced from said atomizing zone, the step of maintaining between the head and the article an electrostatic field capable of electrostatically effecting atomization, dispersion, and deposition of the coating material, the distance between the head and article being equal to at least several times the distance between adjacent ones of the points at which said atomization occurs.

6. A method of electrostatically distributing liquid as a coating on an article, comprising the steps of supplying liquid at a controlled rate, forming the liquid into an extended film and causing the film to flow toward an atomizing zone, atomizing finely divided, discrete particles of liquid at a plurality of closely spaced aligned points at said atomizing zone, and electrostatically dispersing such particles and depositing them on the article as a spray while still in liquid state, the distance between the atomizing zone and the article being materially greater than the film will bridge and great enough to permit the dispersion of the particles as they proceed toward the article under the influence of electrostatic forces.

7. The method of electrostatically distributing liquid as a coating on an article, comprising the steps of supporting a body of liquid coating material in the form of a film having an exposed surface, the terminus of said film being spaced from said article, establishing between said article and the terminus of the film an electrostatic field of such strength as both to be capable of electrostatically atomizing finely-divided, discrete liquid spray particles from said terminus of the film and of electrostatically dispersing such particles and depositing them still as discrete spray particles and while still in liquid state upon the surface of said article to form a finished coating on the same, and continuously and at a controlled rate replenishing in said body the coating material atomized therefrom for deposition by the action of the electrostatic field, the gap between the said terminus of the film and the article being wide enough both to insure that it will not be bridged by the supported liquid coating material and to permit the atomized particles, before being deposited, to be dispersed and distributed over a substantial area.

8. The method of electrostatically distributing liquid as a coating on an article, comprising the steps of positioning a body of liquid coating material in opposed spaced relation to the article, said body having an exposed surface, causing said body to flow forwardly, establishing between the article and the liquid body an electrostatic field of sufficient strength both to electrostatically atomize finely divided, discrete liquid spray particles from a plurality of aligned points so closely spaced as to provide a substantially continuous extended atomizing zone along the terminus of the exposed surface nearest the article and to electrostatically disperse said particles

and to deposit them on the article still in the form of discrete spray particles while still in liquid state, and continuously and at a controlled substantially uniform rate adding additional liquid coating material to said body at a point spaced rearwardly from said terminus to maintain said flow, said terminus and the article being spaced apart by a distance great enough to permit the atomized spray particles, before being deposited, to be dispersed and distributed as discrete spray particles over a substantial area.

9. The method of electrostatically distributing liquid coating material as a coating on an article, comprising the steps of causing the liquid to flow in a continuous stream and at a positively regulated rate to a point of atomization where such stream has an exposed surface, positioning the point of atomization opposite to and spaced from the article to be coated, establishing between the article and the exposed surface of the stream an electrostatic field, and with the aid of said field atomizing discrete particles from said exposed surface, dispersing such discrete particles, moving them through quiescent air and depositing them as a liquid spray on an adjacent article surface to form a finished coating thereon, the distance between the point of atomization and the article being greater than the stream will bridge and great enough that the deposited particles will be distributed over an area having each of its dimensions many times greater than the minimum cross-sectional dimension of the stream at the point of atomization.

10. The method of electrostatically distributing liquid as a coating on an article, comprising the steps of moving the article past and in spaced relation to a zone of atomization, feeding liquid coating material in a relatively narrow stream, spreading said stream to form it into a body of liquid coating material having an extent many times the maximum cross-sectional dimension of said stream, maintaining at such zone of atomization the body of liquid coating material with said body having a plurality of closely spaced aligned exposed termini of relatively small area, establishing between the exposed termini of the coating material and the article moving past it an electrostatic field of sufficient strength that it both electrostatically atomizes small particles of coating material from such exposed termini and electrostatically deposits them still in the form of discrete spray particles while still in liquid state for distribution into a continuous finished coating upon the article as it moves past the zone of atomization, and continuously and at a controlled rate maintaining said stream to supply coating material to said body to replace the coating material atomized therefrom by the action of the electrostatic field, said atomization and deposition both being effected in quiescent air, the direction of movement of said article relative



to said body of coating material being such as to effect a substantial displacement of the article surface transverse to the general direction of the lines of force of the field during particle deposition to cause such lines of force to sweep such article surface, the spacing of said body of coating material from the article being great enough that the atomized particles will disperse under the action of the field as they move toward the article until they are distributed over and deposited onto a portion of the article surface having an area many times the area of the exposed termini.

11. A method of electrostatically depositing liquid as a coating on an article, comprising the steps of supplying liquid as a film to an extended atomizing zone in spaced relation to the article, atomizing discrete particles of the liquid as a spray from said zone, force feeding the zone with liquid at a controlled rate to replace that so atomized, dispersing said particles widely transversely and longitudinally of the extent of the atomizing zone, and creating an electrostatic charge differential between the particles and the article of a strength to move the particles toward the article sufficiently rapidly to deposit them thereon while still in liquid state and while still so dispersed, the movement of the spray particles being through a quiescent atmosphere whereby the electrostatic forces effect deposition on an adjacent article surface of spray particles which would have otherwise not deposited on the article surface, the distance between the article and the atomizing zone being great enough to permit said dispersion of the finely divided liquid spray particles as they proceed toward the article under the influence of electrostatic forces.


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June 4, 1957 W. A. STARKEY ET AL 2,794,417

# APPARATUS FOR ELECTROSTATICALLY COATING ARTICLES

Original Filed Sept. 29, 1944 2 Sheets-Sheet 1

FIG. 1

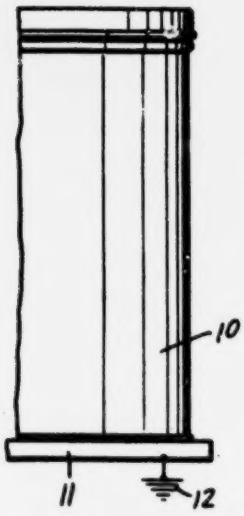



FIG. 2

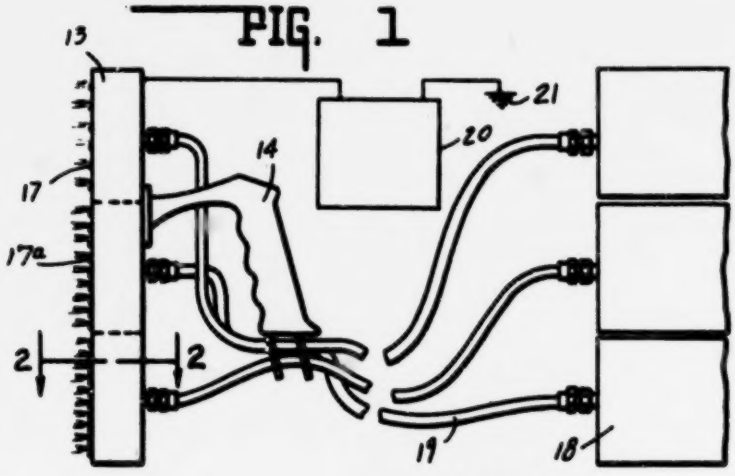



FIG. 3

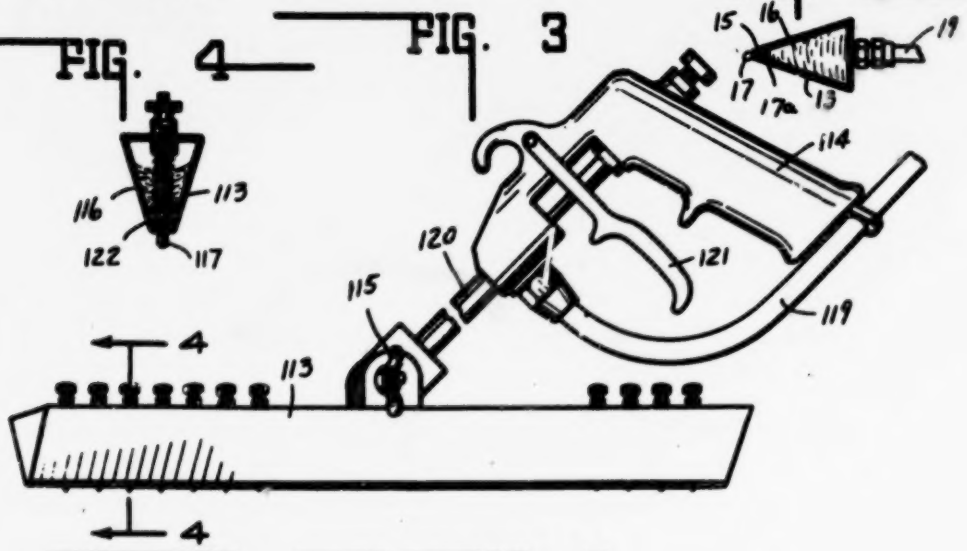



FIG. 4




FIG. 5

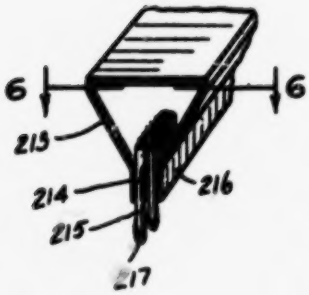
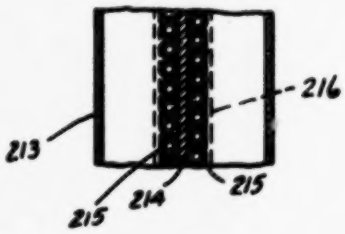



FIG. 6

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APPARATUS FOR ELECTROSTATICALLY COATING ARTICLES

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FIG. 7

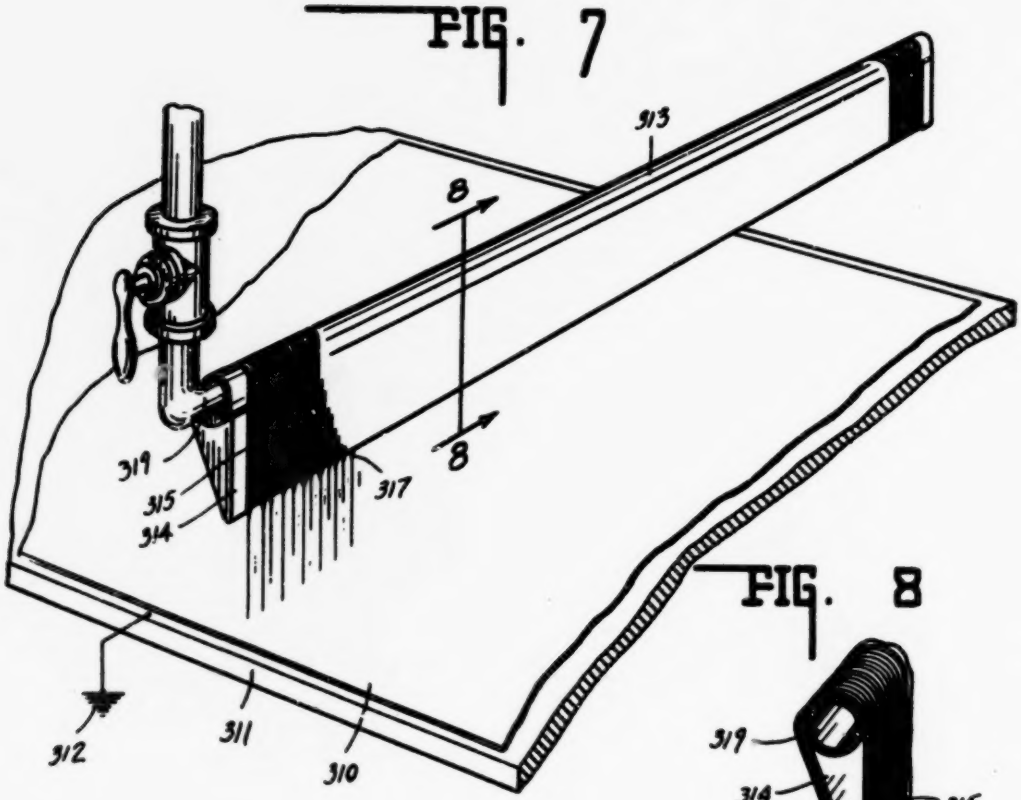



FIG. 8

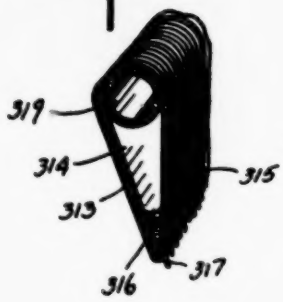
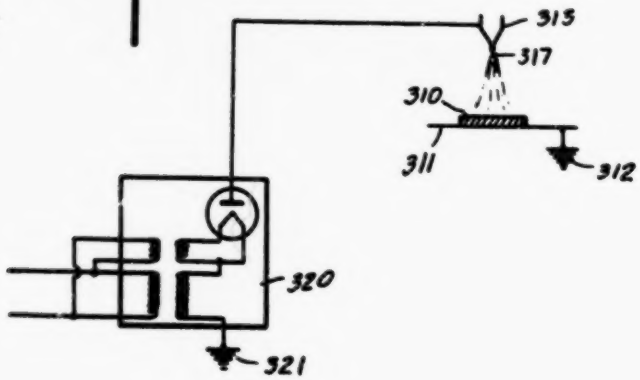



FIG. 9

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United States Patent Office

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2,794,417

# APPARATUS FOR ELECTROSTATICALLY COATING ARTICLES

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Original application September 29, 1944, Serial No. 556,390, now Patent No. 2,685,536, dated August 3, 1954. Divided and this application June 4, 1954, Serial No. 434,366

4 Claims. (Cl. 118—51)

This application is a division of our copending application Serial No. 556,390, filed September 29, 1944, now Patent No. 2,685,536, granted August 3, 1954. That patent describes a method and apparatus for electrostatically coating articles with a liquid coating material such as paint, lacquer, ink, wax and the like. Such articles to be coated may be of either conducting or non-conducting material, may be structural in character or comprise fabric or paper sheets.

This application is particularly directed to forms of apparatus suitable for use in carrying out methods claimed in our aforesaid patent.

In respect to the method of electrostatically coating articles by discharging a spray of coating material from an air operated or air atomizing spray gun reference may be made to such prior patents as Pugh, No. 1,855,859, issued April 26, 1932, for "Method and Apparatus for Coating Articles," and Ransburg and Green, Nos. 2,247,963 and 2,334,648, issued July 1, 1941, and November 16, 1943, for "Apparatus for Spray Coating Articles" and "Method of Spray Coating Articles," respectively.

However, in the use of spray guns or the like many disadvantages develop in that the air operated spray gun is limited to a comparatively small field of dispersion, but more important it causes the coating material to be discharged in non-uniform sized particles, and in variable patterns. Thus, there is an uneven dispersion of the coating particles over the surface to be coated due to the inertia generated in the discharge, causing the larger particles to travel further in the field than the more finely divided particles. In some arrangements, depending upon the direction of the discharge, a variable pattern of spray is created and reproduced on the surface to be coated, the heavier coating particles being caused to impinge over one area and the more finely divided particles over another area. By reason of such variance it has been found necessary in practice under certain conditions of coating to arrange a sizable battery of spray guns with particular regard to their variable patterns of coating application so that the several guns complement each other to even out the pattern as a battery.

It is the purpose of our invention to meet this problem of coating articles in an electrostatic field by eliminating the use of such spray guns and employ in place thereof a new method and apparatus for supplying the coating material for electrostatic precipitation upon the surface to be coated. This is accomplished by providing in the field a series or plurality of small inert droplets of coating material and establishing such electrostatic force in the field as to develop and transmit finely divided particles of coating material from said droplets to the surface of the article to be coated. In describing as "inert" the drops or droplets from which atomization takes place, it is our purpose to indicate that during the coating process each drop is supported on the head as above described, and that while the drop may be continuously



giving off liquid for atomization, replacement enables its identity as a supported body of liquid to be maintained.

Such method and apparatus has several important advantages over the spray gun arrangements heretofore employed. The coating material may be introduced into the electrostatic field by an applicator head having a series of orifices through which the material may ooze in the form of inert droplets. Such applicator head may be substantially coextensive with the surface to be coated and thereby take the place of a battery of spray guns as heretofore employed. The droplets will be developed into finely divided particles by the electrostatic force so that all particles will be transmitted or precipitated upon the surface to be coated uniformly over the entire surface.

A feature of the invention, as above described, resides in the applicator head including formation of the discharge orifices therein and the control of the rate of discharge of the material to form the inert droplets at approximately the rate of their electrostatic discharge. Thus, depending upon the viscosity and other characteristics of the material, the control of the applicator head will be such as to permit discharge of just the right quantity and size of the droplets to effect the greatest efficiency in coating a surface.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims.

Fig. 1 is a diagrammatical illustration showing one arrangement of applicator in respect to the article to be coated. Fig. 2 is a section taken on the line 2—2 of Fig. 1. Fig. 3 is a perspective view of a modified form of applicator with a control handle associated therewith. Fig. 4 is a section taken on the line 4—4 of Fig. 3. Fig. 5 is a perspective sectional view showing a portion of a further modification of the applicator head. Fig. 6 is the same as Fig. 5, taken on the line 6—6 thereof. Fig. 7 is a perspective view of a further modification of the applicator head in association with the surface to be coated. Fig. 8 is a section taken on the line 8—8 of Fig. 7. Fig. 9 is a diagrammatical illustration of the circuit and one of the arrangements of the applicator head relative to the article to be coated.

The invention is illustrated by one modification thereof in Figs. 1 and 2 wherein there is shown an article 10 to be coated mounted or carried upon a suitable support or conveyor 11 which is grounded at 12. An applicator head 13 is provided which is preferably substantially coextensive with the surface to be coated. Said applicator head may be fixedly or adjustably mounted on a suitable support, or hand manipulated by a handle 14. The applicator head, as indicated in Fig. 2, is V-shaped in cross section and along its reduced discharge end 17*a* it is provided with a series of orifices 15 through which the coating material indicated at 16 may be oozed out in the form of droplets 17. The applicator head may be connected with a source of supply of coating material by a flexible tube, there being herein illustrated three compartments in the head, each connected with an individual source of supply 18 by a tube 19. The discharge edge 17*a* has an extent many times the maximum cross-sectional dimension of the passageways provided by the tube 19. Sufficient pressure will be created in the containers forming the source of supply 18 for maintaining the material 16 in the head under just the proper pressure to cause the droplets to ooze therefrom as they are dispersed by the applied electrostatic force.

As illustrated, the applicator head is connected to a source of high voltage indicated at 20 through one terminal thereof, the other terminal of said source being grounded at 21 and through ground connected with an article 10 to be coated. Accordingly, the space or field between the applicator head and article 10 is electrostati-

cally charged by reason of the article being grounded and the applicator head being at high potential. The effect thereof is to cause an electrical force to act on the droplets 17, causing them to be broken up into finely divided or minute particles of coating material, such as to be attracted to the grounded article for deposition thereon. Thus, the grounded article may be referred to as a collecting electrode of one potential with the applicator head serving as a discharge electrode of a different potential. It is found that the electrostatic force set up in the field between the electrodes is such as to develop and transmit finely divided particles of the droplets 17 from one electrode to the other. In this connection it will be noted that as the droplets are caused to slowly ooze from the applicator head they are inactive or inert, but subject to being broken up into finely divided particles and distributed over the surface of the opposed electrode. The same action will take place wherein the applicator head may be grounded and the article directly connected with the source of high voltage and thus be charged at a high potential.

Another modification is illustrated in Figs. 3 and 4, wherein the applicator head 113 is adjustably supported by the handle 114 through a pivotal connection secured by thumb nut 115. The hose 119 leading from a source of coating material maintained under pressure, is connected with a valve operated conduit 120 controlled by the finger operated valve 121. Also, the droplets of coating material 117 may be controlled, depending upon the viscosity of the material indicated at 116 by a needle adjustment 122, which needle adjustably controls the orifice through which the material 116 is forced to provide the desired inert droplets.

Figs. 5 and 6 show a further modification of the applicator head indicated at 213. In this head the orifices through which the coating material flows are provided by a plate 214 clamped between opposed rows or needles 215. The needles are cylindrical so that the material will be caused to flow between them, the plate 214 and the clamping walls 216 so as to come out in the form of an inert droplet 217 of coating material. As illustrated in the drawings, the needles are sufficiently close together as to cause the coating material to bridge the spaces therebetween.

In the modification of Figs. 7 and 8 there is illustrated a grounded surface 310 to be coated. This may be a continuously moving sheet of paper or any other article, it being understood that wherein such article or material is non-conducting, it is carried by and on a support or conveyor 311 of grounded conducting material. In this arrangement the applicator head 313 is supported across and above the surface to be coated, and coating material is fed thereto through the valve controlled pipe 319 leading from the source of such material. Said pipe extends through the head, having a series of orifices or openings therein through which the material may drip by gravity. Mounted on and connected to a source of high voltage through the pipe 319, there is a supporting shield 314 extending downwardly and terminating below the pipe to provide a frame for a wire wrapping 315. The coating material accumulates from the drippings into a pocket formed by the wire wrappings, as indicated at 316. The wire wrappings are slightly or sufficiently spaced to permit the coating material to slowly ooze or drip therebetween from the accumulation in the pocket indicated at 316 to form the droplets 317. In this instance the discharge or oozing of the material from the applicator head is aided by gravity, the droplets being thereupon broken up or developed into finely divided particles by the electrostatic force developed between the applicator head and the surface to be coated. Such finely divided particles will thereupon be dispersed by the electrostatic force over said surface and be applied to said surface. The applicator head can be grounded and the work maintained at high potential with equally efficient results.

By way of example, the arrangement of the overhead applicator of Fig. 7 is shown diagrammatically in Fig. 9, wherein the source of high voltage indicated at 320 has one terminal grounded at 321 and the other terminal connected with the applicator head 313 which is thereby maintained at high potential relative to the support or conveyor 311, which is connected with ground at 312.

As above pointed out, it is immaterial as to whether the article or the applicator head comprises the grounded electrode, since the electrostatic force set up therebetween will have the same effect on the droplets of coating material. Also, it is immaterial as to whether or not the article to be coated is of conducting or non-conducting material, and such article of non-conducting material is herein considered to be one of the electrodes wherein it is associated with or masks a grounded support of conducting material.

The invention claimed is:

1. In apparatus for electrostatically applying liquid coating material to an article, an atomizing head positioned adjacent the article to be coated, said head comprising a group of elongated members and means for encasing said members and intimately compacting them together, said members projecting for a portion of their length beyond said encasing means, means for maintaining between said projecting member portions and the article an electrostatic field of sufficient strength both to electrostatically atomize fine particles from coating material on the surfaces of said projecting portions and to electrostatically deposit on the article the particles so atomized, and means for supplying liquid coating material to said members from their encased ends to the surfaces of said projecting portions at a rate no greater than that at which it is electrostatically atomized.

2. In an apparatus for electrostatically coating an article with a liquid coating material, an elongated, hollow applicator head comprising supporting means having thereon a wire wrapping having a series of spaced turns, portions of which constitute projections and the spaces between which constitute restricted orifices through which liquid coating material can flow to the surfaces of said projections, means for supplying liquid coating material to the interior of said head, and means for creating between said head and an article to be coated an electrostatic field of sufficient strength both to electrostatically atomize finely divided particles from coating material on the surfaces of said projections and to electrostatically deposit upon the article the particles so atomized.

3. Apparatus for electrostatically coating an article with a liquid coating material, comprising a conveyor for moving the article over a predetermined path, a single-fluid atomizing head provided with a liquid supporting, flow-guiding surface having a terminus adjacent which liquid coating material is to be atomized, means for supplying liquid coating material at a controlled rate to said surface at a point spaced rearwardly from said terminus for flow as an exposed body over the surface to said terminus for atomization therefrom, and means including a high-voltage source having its opposite terminals electrically connected to the article on the conveyor and the liquid at said terminus for establishing an electrostatic field therebetween capable of atomizing the liquid from said exposed body at said terminus in the form of a spray and electrostatically depositing the spray on the article while still in liquid state, said head and conveyor being spaced apart by a distance great enough to permit the atomized liquid leaving said member to be widely dispersed.

4. Apparatus for electrostatically spray-coating an article, comprising an atomizing head, means for feeding liquid coating material to said head, means including said feeding means for distributing coating material to an extended atomizing zone where it is atomized from a plurality of spaced points, said points being sufficiently close together to permit the coating material to bridge the spaces therebetween, a support for supporting an article

to be coated in spaced relation to said atomizing zone, and means including a high-voltage source for creating over the surface of the article on said support an electrostatic field capable of atomizing the coating material into finely divided, electrically charged particles and electrostatically depositing particles atomized from said atomizing zone on the article while still in liquid state, said atomizing head and support being so relatively disposed as to provide between the article and the atomizing zone a spacing great enough to permit substantial dispersion of the atomized particles by the electrostatic forces of the field.




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July 7, 1959 W. W. CROUSE 2,893,893

METHOD AND APPARATUS FOR ELECTROSTATIC COATING

Filed Jan. 31, 1950 4 Sheets-Sheet 1

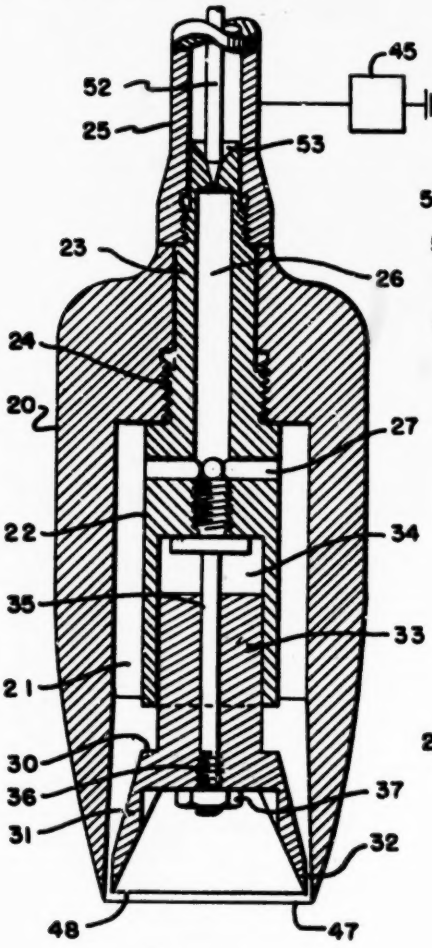


Fig. 1

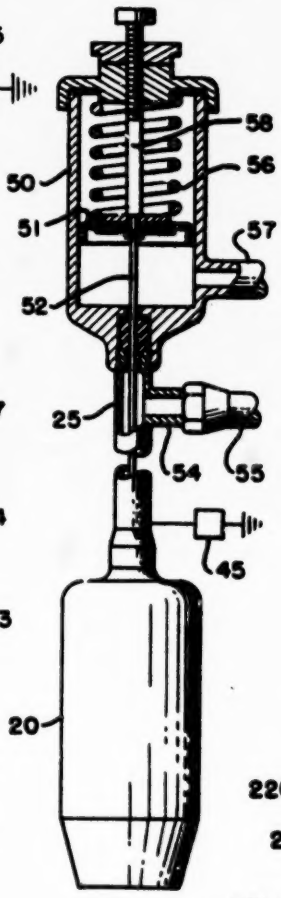


Fig. 2

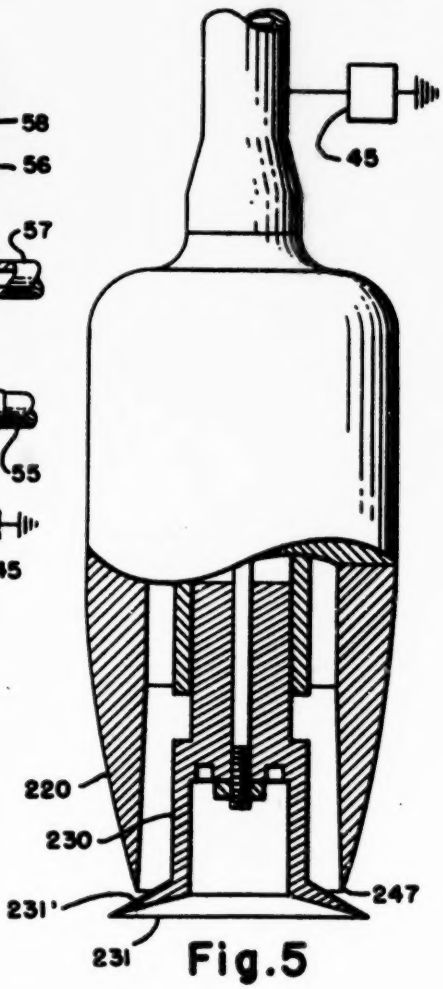


Fig. 5

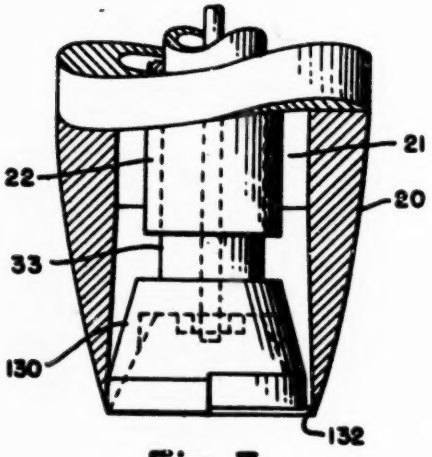


Fig. 3

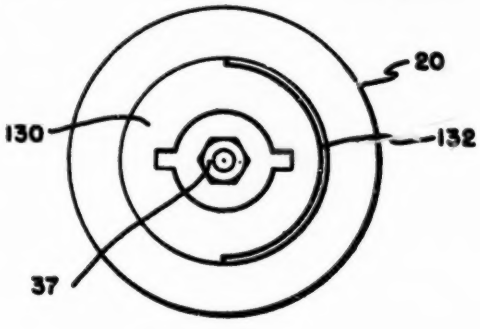


Fig. 4

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METHOD AND APPARATUS FOR ELECTROSTATIC COATING

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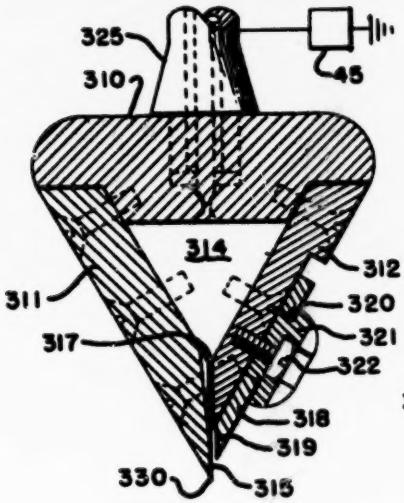


Fig. 6

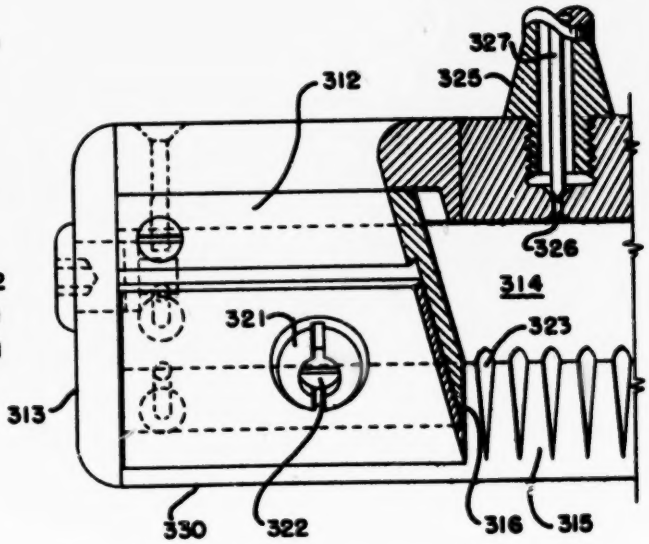


Fig. 7

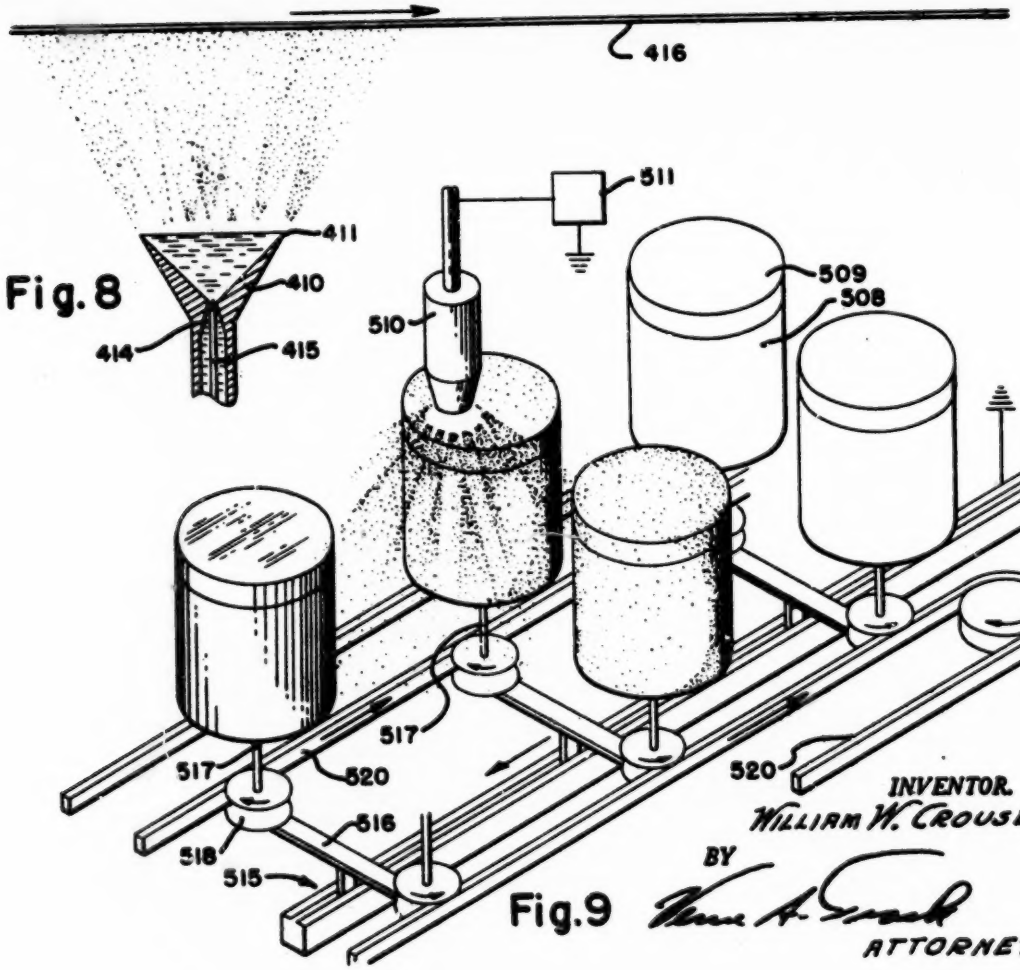


Fig. 8

Fig. 9

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July 7, 1959 W. W. CROUSE 2,893,893

METHOD AND APPARATUS FOR ELECTROSTATIC COATING

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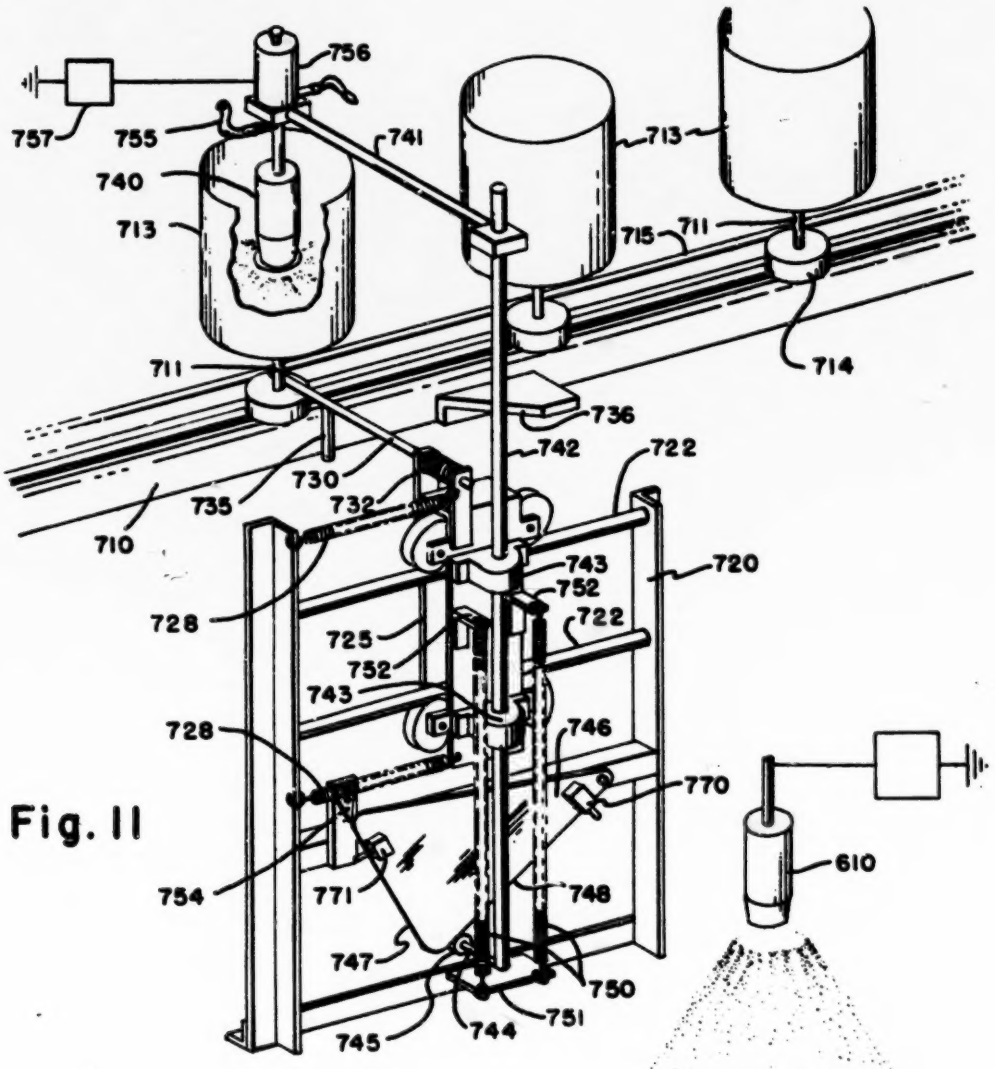


Fig. 11

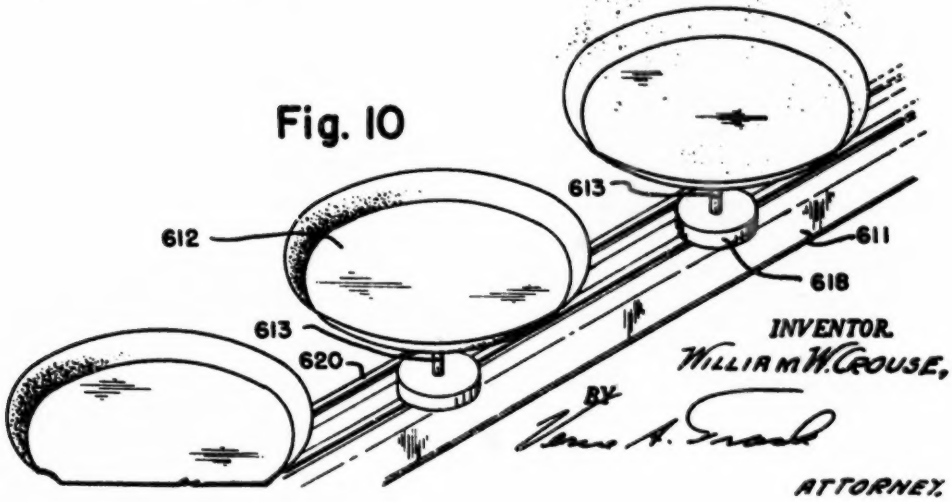


Fig. 10

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METHOD AND APPARATUS FOR ELECTROSTATIC COATING

Filed Jan. 31, 1950 4 Sheets-Sheet 4

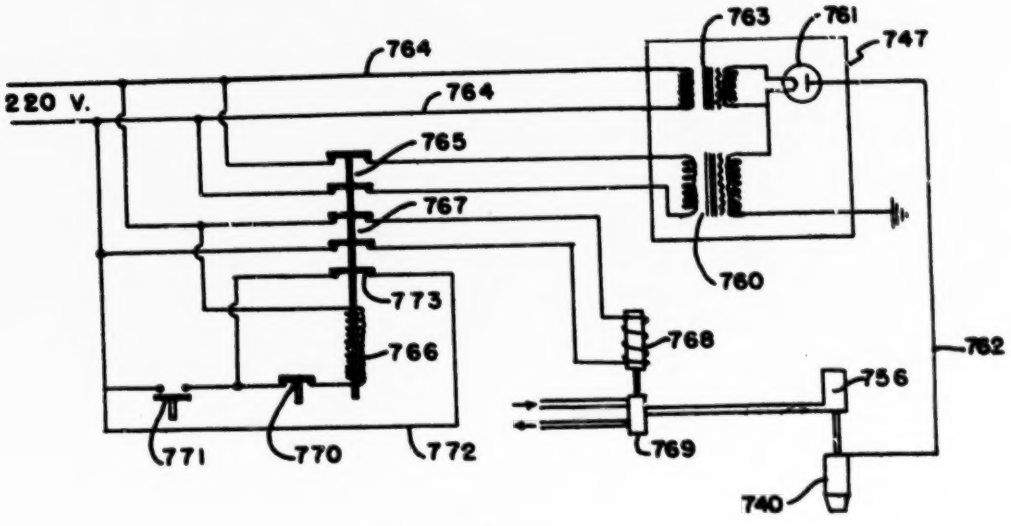


Fig. 12

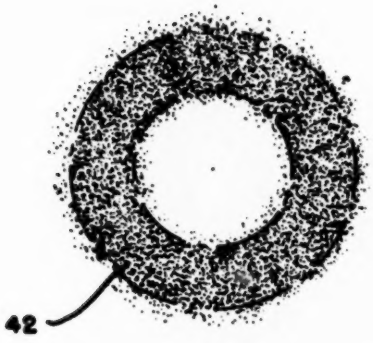


Fig. 13

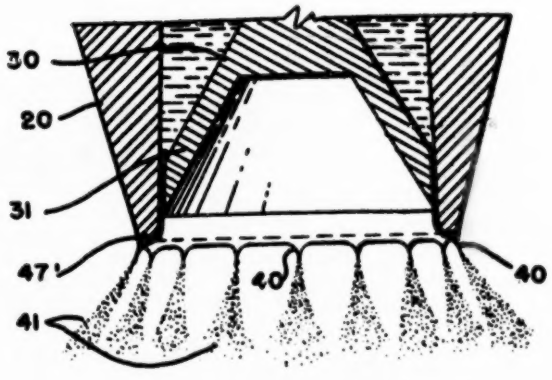


Fig. 14

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United States Patent Office

2,893,893

Patented July 7, 1959



2,893,893

# METHOD AND APPARATUS FOR ELECTROSTATIC COATING

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Application January 31, 1950, Serial No. 141,509

12 Claims. (Cl. 117—93)

This application relates to improvements in methods of and apparatus for effecting the atomization of liquids, and especially in electrostatic coating methods and apparatus adapted for use in the application of liquid coatings. The application is a continuation in part of my prior application Serial No. 13,174, filed March 5, 1948, now abandoned.

Electrostatic fields have been utilized in the art of coating for some time in the past. For example, U.S. Patent No. 2,247,963 issued July 1, 1941, to Harper J. Ransburg Co. discloses a method and apparatus in which paint or other coating material, after atomization, is sprayed in particled form into an electrostatic field by which it is deposited on articles to be coated. Patent No. 2,359,476, granted October 3, 1944, also to Harper J. Ransburg Co., discloses a method and apparatus in which an electrostatic field is employed to remove liquid coating material which appears in the form of concentrated accumulations on articles which have been dip-coated.

In the printing art, it has been proposed to employ an electrostatic field to effect, or to aid in effecting, the transfer, usually in pattern, of ink or other liquids between two surfaces which are lightly in contact with each other or which are separated by narrow gaps—gaps varying from a few thousandths to a few hundredths of an inch.

Prior application Serial No. 556,390, filed September 29, 1944, by Edwin M. Ransburg and William A. Starkey, now Patent No. 2,685,536, discloses a method and apparatus in which an electrostatic field was employed both to atomize liquid coating material and to deposit the particles formed by such atomization. According to that application, the liquid coating material was atomized at one or more points, each the site of a more or less discrete drop or small liquid body from the surface of which the electrostatic atomization took place. To replace the coating material removed from each drop or body by atomization, provision was made for replenishing it with an individual stream of coating material.

The use of a single electrostatic field to produce both electrostatic atomization and electrostatic deposition of coating materials has many advantages. The proportion of coating material which is atomized and escapes deposition on the article is greatly reduced, and as a whole the process is highly efficient; it reduces and in many cases completely eliminates the necessity for ventilation; it permits a reduction in the space required for performing coating operations; the necessary apparatus is considerably simplified; and coating can be carried on under much cleaner conditions. However, the method and apparatus specifically disclosed in the aforesaid prior application Serial No. 556,390 has a disadvantage in that it is difficult to provide satisfactory control of the individual coating-material streams which are employed to replenish the drops or small bodies from which the atomization takes place. Without such control, some of the bodies might be inadequately replenished to cause localized impoverishments in the spray pattern while others might receive liquid at too great a rate.



It is accordingly the primary object of the present invention to provide a method and apparatus by which a liquid may be atomized at a plurality of points without the necessity for structural features supporting more or less discrete bodies or drops of the liquid and without the necessity for providing and controlling in a coordinated manner a plurality of streams flowing to the respective points of atomization.

Other objects of the invention are the provision of an improved method of and apparatus for electrostatically coating articles, the promotion of the efficient use of coating material through more effective atomization, the obtaining of better control of atomized coating material, and the promotion of uniform coating thickness.

An additional object of the invention is to simplify the coating of the interior surfaces of hollow articles, or of concave surfaces generally.

Still another object of the invention is to provide electrostatic coating apparatus which is considerably simplified, efficient in use, compact, and clean in operation.

The present invention involves my discovery that in order to effect electrostatic atomization of liquids at a plurality of points it is not necessary to provide structural features for supporting more or less discrete bodies or small drops of liquid or for feeding liquid to points of atomization in independent streams. Specifically, I have discovered that if the liquid is fed as an extended, thin stream or film and if an electrostatic field of sufficient strength is maintained along the leading edge of such stream or film, the field will act to distort the film edge and form it into a series of cusps, the bases of which will be continuous with the film or stream of liquid. The electrostatic atomization takes place from the tip of each cusp, the atomized material forming a divergent spray of discrete particles which carry electrical charges and which are electrostatically projected away from the film. The pattern of the spray formed by the aggregate of the jets originating at the tips of the cusps may be controlled to a large extent by controlling the cross-sectional shape of the liquid film or stream at the edge of which the cusps form. If the liquid film or stream is plane, the cusps will lie in a straight line and the spray will be generally prismatic in form. If the film is annular, the cusps will lie on a circle and the spray will have a hollow, frusto-conical form. If the field-strength along the film-edge is uniform, the cusps formed along the edge of the film tend to space themselves at equal intervals, probably due to forces of mutual electrical repulsion; and if the film is an annular film, the cusps will be uniformly distributed around its annular edge.

In practicing the invention, I employ an atomizer having a discharge member having an extended surface adapted to define one face of the film of liquid from the edge of which atomization is to take place, such discharge-member surface desirably having its terminal portion exposed so that the film on such terminal portion will be free-surfaced and will tend to distribute itself uniformly as it flows toward the edge where atomization occurs. Associated with the discharge member I provide means for feeding the liquid to the film-defining surface. The shape of the discharge member, and more particularly the shape of its film-defining surface, in a plane transverse to the direction of film-flow determines the cross-sectional shape of the film and the shape of the film-edge along which atomization occurs. The discharge member may be formed to provide an annular film and a circular discharge edge, a plane film and a straight discharge edge, or may be otherwise formed.

In electrostatic coating, the process of the invention

may be carried out by presenting in a predetermined position the leading edge of an extended, thin stream of liquid coating material and moving an article past such leading edge and in spaced relation thereto while an electrostatic field is maintained between such edge and the article. In quantity production, a plurality of articles may be mounted on a conveyor so as to be brought successively into opposed relation with the film-edge. The film will be formed and supported by an atomizer, as above set forth; and the discharge member of the atomizer will of course be disposed so that the leading edge of the liquid film is presented generally toward the article-path, and will be so constructed and disposed as to avoid electrical shielding of the film-edge from which atomization takes place.

Control of the supply of liquid material to and distribution of liquid along the film-defining surface of the discharge member may be obtained in any convenient manner, as by associating with the discharge member a control or regulating member spaced from the film-defining surface of the discharge member to provide an extended orifice through which the liquid flows to form the aforesaid film.

In the drawings:

Fig. 1 is an axial section of one form of atomizer embodying the invention;

Fig. 2 is a side elevation of the atomizer shown in Fig. 1 in association with the liquid source and its controls;

Fig. 3 is a fragmental side view, partially in section, showing a modification of the atomizer of Fig. 1;

Fig. 4 is a bottom end view of the atomizer shown in Fig. 3;

Fig. 5 is a side elevation partly in section of another form of atomizer embodying the invention;

Fig. 6 is a transverse section of still another form of atomizer;

Fig. 7 is a partial side view, partially in section, of the atomizer shown in Fig. 6;

Fig. 8 is a side view in section of yet another form of atomizer as it may be used for coating;

Fig. 9 is an isometric view of coating apparatus which incorporates the atomizer shown in Figs. 1 and 2;

Fig. 10 is an isometric view of another form of coating apparatus incorporating the atomizer shown in Figs. 1 and 2;

Fig. 11 is a perspective view of coating apparatus suitable for use in coating interior surfaces;

Fig. 12 is a wiring diagram illustrative of the operating electrical circuits for the apparatus shown in Fig. 11;

Fig. 13 shows in a general form a pattern which is obtained by the atomizer shown in Fig. 1; and

Fig. 14 is a fragmental view similar to Fig. 1 illustrating the manner in which atomization occurs.

The atomizer shown in Figs. 1 and 2 is designed to produce an annular spray pattern. It comprises a body 20 of circular cross-section disposed with its axis vertical and provided at its lower end with an axial recess 21 also of circular cross-section. The lower portion of the body 20 serves as the discharge member and the wall of the recess 21 constitutes the surface that shapes and supports an annular film of liquid from the lower edge of which atomization is to occur. To adapt the body member 20 for connection to a source of liquid, I may employ a stem 22 having a shank 23 of reduced diameter which is screw-threadedly received in the body member 20 as shown at 24 and which projects upwardly through and beyond the top thereof, where it is screw-threaded for connection to a pipe 25. The shank 23 has an axial passage 26 which joins one or more radial passages 27 providing communication between the passage 26 and the upper end of the recess 21.

In order to form liquid supplied to the recess 21 into the desired annular film, the device of Figs. 1 and 2 embodies a control or regulating member in the form



of a plug 30 having a circular head 31 coaxial with the recess 21 and of slightly smaller diameter than such recess to provide an annular passage 32 through which liquid in the recess flows downwardly in the shape of the desired annular film. In addition to distributing the liquid in the form of an annular film, the plug-head 31 may be arranged to vary the thickness of the film. For that purpose, the lower end of the recess 21 is given a slight outward taper and the plug 30 is mounted for axial adjustment relative to the body 20. To provide uniform thickness of the annular liquid film, the plug-head 31 should be maintained accurately concentric with the recess 21; and the plug is therefore provided with a pilot 33 slidably received in an axial cylindrical recess 34 in the stem 22. The axial position of the plug, and hence the effective cross-sectional area of the annular passage 32, may be controlled through a rod 35 which is secured at its upper end to the stem 22 and which extends downwardly through the stem. The stem is screw-threadedly mounted on the rod, as shown at 36; and below the stem the threaded rod-end is provided with a lock nut 37 to secure the plug in any desired position of axial adjustment.

If the leading edge of the annular film discharged through the annular passage 32 in the device of Fig. 1 is made one terminal of an electrostatic field of suitable strength, such leading film-edge will be drawn into a series of spaced, sharply pointed cusps 40 (see Fig. 14) from the tips of which liquid will be electrostatically atomized. The liquid particles leaving each cusp-tip will form a divergent jet 41, and the aggregate of all such jets will form a hollow frusto-conical spray. If the field strength and film-thickness are uniform over the extent of the leading edge of the annular film, the cusps 40 will be uniformly spaced about the circumference of such film, probably due to mutual forces of repulsion created by the field. If the opposite terminal of the field is an extended flat sheet normal to the axis of the atomizer, the liquid atomized from the tips of the cusps 40 will be deposited on such sheet in an annular pattern, as indicated at 42 in Fig. 13. In that figure, the density of the stippling employed to illustrate the pattern indicates in a general way the density of the deposited liquid. By moving the sheet in its own plane, the deposited liquid can be made to form a band having a width equal to the outer diameter of the annular pattern.

In order to make the leading edge of the annular film one terminal of an electrostatic field the other terminal of which is an article to be coated, the body member 20 of the atomizing device may be made of metal or other conducting material and connected to one terminal of a high-voltage source 45, conveniently through the pipe 25 which is made of metal. If this arrangement of electrical connections is used, the opposite terminal of the high-voltage source 45 may be grounded; and if the atomizer is to be used for coating an article, such article is disposed opposite the atomizer and may be electrically grounded. As a result of the electrostatic field thereby created between the leading edge of the film at the lower end of the body-member 20 and the article to be coated, the liquid is atomized to form a spray as above described, and the particled liquid constituting the spray moves under the influence of the electrostatic forces of the field toward the article, becoming dispersed meanwhile, and is eventually deposited on the article.

For best results, an atomizing device, if made of conducting material, should be so formed and disposed as to promote concentration of field-strength in the vicinity of the leading edge of the liquid film and uniformity of field-strength along such leading edge. For that reason, the portion of the device nearest the leading film-edge should be closer to the article than is any other portion of the device. For the same reason, the film-supporting portion of the body 20 is desirably attenuated in character. In the device of Fig. 1, the desired attenuation

is attained by tapering the outer surface of the body until it meets the wall of the recess 21 at a narrow edge 47. The lower end of the plug 30 is located above the edge 47 and is desirably provided with a central recess the wall of which meets the exterior surface of the plug-head 31 in a narrow edge 48. When a head so constructed is disposed in opposed spaced relation to an oppositely charged article, the lines of force of the field will be relatively concentrated at the edge 47 to produce a high field-strength at the points where atomization of the liquid occurs.

In the device of Fig. 1, the edge 47 is shown as a knife edge, but it is not essential that it be so. The extreme attenuation provided by a knife-like edge such as is shown in Fig. 1 promotes a high degree of atomization of the liquid; but for many purposes, the edge may be blunt, as indicated at 47' in Fig. 14 and satisfactory atomization will still be obtained.

In Fig. 2 I have illustrated means for controlling the supply of liquid to the atomizing device from a remote point. In that arrangement a pneumatic cylinder 50 is mounted on the upper end of the pipe 25, such cylinder containing a piston 51 connected to a valve member 52 which extends downwardly through the pipe 25 and co-operates with a valve seat 53 (Fig. 1) provided in the upper end of the shank 23. The pipe 25 has a lateral branch 54 adapted for connection to a liquid supply conduit 55. A compression spring 56 located within the cylinder 50 urges the piston 51 downwardly and the valve member 52 toward its seat 53; and the lower end of the cylinder communicates with a conduit 57 through which air or other fluid under pressure may be admitted to force the piston 51 upwardly and to open the valve. Upward movement of the piston, and hence the opening of the valve, may be limited by an adjustable stop screw 58 mounted in the upper head of the cylinder 50.

The atomizing device illustrated in Figs. 3 and 4 is essentially the same as that shown in Fig. 1 except that it is adapted to produce a liquid film which is arcuate rather than completely annular in cross-section. To accomplish this result, the plug 30 of the device shown in Fig. 1 is replaced by a plug 130 having an external diameter equal to the diameter of the recess 21 in body member 20, such plug being relieved over a portion of its periphery to provide a passage 132 of arcuate form in cross-section and, as shown, of approximately 180° in circumferential extent. The liquid film will have substantially the same shape at its leading edge, and the pattern produced on an extended flat surface will be generally semi-circular.

The atomizer shown in Fig. 5 resembles that shown in Fig. 1 in that the liquid film is annular but differs from the atomizer of Fig. 1 in that the film is more conical than cylindrical in form. In this construction, insofar as formation of the film is concerned, the functions of the atomizer-body 220 and of the plug 230 are reversed, the film being supported on the upper, outwardly and downwardly sloping annular surface of a flange 231 provided at the lower end of the plug 230. The flange 231 extends outwardly beyond the lower edge 247 of the body 220, such edge serving as the control or regulating member which determines the thickness of the film. The plug 230 can be adjusted axially of the body 220 to vary the spacing between the upper surface 231' of the flange 231 and the lower edge 247 of the body and hence to vary the thickness of the film.

When positioned opposite and in spaced relation to an extended flat plate normal to its axis, the atomizer of Fig. 5 produces an annular pattern generally similar to that shown in Fig. 13, although for a given diameter of atomizer, both the inner and outer diameters of such pattern will be larger than those of the pattern produced by the atomizer of Fig. 1. The atomizer of Fig. 5 is especially adapted for the application of liquid coating material to recess walls or to the inner surfaces of hollow articles, as will be more fully brought out hereinafter.

It will be noted that in the atomizer shown in Fig. 5 the liquid forming the film, after passing through the control opening defined by the lower edge 247 of the body 220, spreads, or flows with a substantial radial component of velocity. As the film spreads in such manner it becomes thinner and has at its periphery a thickness considerably less than the width of the control opening defined by the lower edge of the body 220. Control of a radially spreading film at a point spaced inwardly from its periphery is of advantage in that the width of the control opening can be considerably greater than the thickness of the film at the edge from which atomization occurs, and the wider control opening thus permitted is easier to adjust and less liable to become occluded.

If the flange 231 is of conducting material and if the atomizer is used in the electrostatic coating of an oppositely charged article disposed opposite its end, the exposed film on the upper surfaces of the flange will be electrically shielded to a great extent, although not completely. As the extreme peripheral edge of the film will be exposed to the field, such shielding as exists is not detrimental, and in some instances, may be an advantage.

The atomizer illustrated in Figs. 6 and 7 differs from any so far described in that the liquid film is plane and atomization occurs from points disposed in a straight line. Such atomizer has the general form of a hollow triangular prism and comprises a horizontal top wall 310, downwardly converging side walls 311 and 312, and end walls 313 which cooperate to define an elongated chamber 314 of triangular cross-section. The side walls 311 and 312 are provided at their lower ends respectively with opposed parallel faces 315 and 316 spaced apart to define a narrow, elongated passage 317 through which liquid in the chamber 314 may escape to form the film from whose lower edge atomization is to take place. The thickness of such film may be controlled by the width of the passage 317 or, if desired, one of the side walls of the atomizer may be provided with an adjustable control member for that purpose. In the particular arrangement illustrated, the wall 311 extends downwardly below the lower edge of the wall 312, and an adjustable control member in the form of a plate 318 is adjustably secured on the wall 312. The plate 318 has a control face 319 disposed in opposed relation to the face 315 of the side wall 311. By movement of the plate 318 obliquely upward or downward along the side wall 312, the distance between the opposed faces 315 and 319 can be varied to vary the thickness of the liquid film. To adjust the plate 318, it may be provided at intervals along its length with slots 320 each of which receives an eccentric collar 321 secured to the side wall 312 by a screw 322. By loosening the screws 322 and rotatably adjusting the collars 321, the plate 318 may be adjusted to move its control face 319 either toward or away from the opposed face 315 of the side wall 311, and when the desired adjustment has been completed the screws 322 may be tightened. If desired, the face 315 of the side wall 311 may be provided with a longitudinally extending series of spaced grooves 323 to aid in the feeding of liquid from the chamber 314. Such grooves, if present, may extend downwardly below the lower edge of the side wall 312, but desirably terminate above the lower edge of the control member 318.

The atomizer shown in Figs. 6 and 7 may be supplied with liquid through a pipe 325 screw-threadedly connected with the top wall 310, the liquid entering the chamber 314 through an opening 326. The upper end of the opening 326 may constitute a valve seat with which there cooperates an axially movable valve member 327 extending upwardly through the pipe 325.

It will be noted from Figs. 6 and 7 that the lower edge 330 of the surface 315 is located below the lower edge of the control member 318. If the atomizer, and par-

ticularly the wall 311, is raised to a suitable potential, liquid escaping from the chamber 314 through the passage 317 forms on the lower portion of the surface 315 a free-surfaced film from the lower edge of which atomization takes place in the manner previously described. The thickness of such film is controlled by adjustment of the control member 318. It is not essential that the edge 330 of the side wall 311 be located below the lower edge of the control member 319; for, if desired, the control face of the member 318 may extend downwardly below the edge 330, in which event the free-surfaced film would be supported on the face 319 and atomization from the film would occur adjacent the lower edge of such face. In fact, it is not essential that the lower edge of one of the faces defining the terminal portion of the liquid passage be located beyond the other; but that feature, like the knife-edge 330 shown, contributes to a concentration of field strength and hence promotes fineness of atomization. If maximum fineness of atomization is deemed unnecessary or undesirable, the terminal edges of the two passage-defining faces might be located at the same level, or if one edge is located beyond the other it might be rounded, like the edge 47' in Fig. 14.

In using the atomizer of Figs 6 and 7 in electrostatic coating, it is desirably positioned opposite an article to be coated and so disposed, if possible, that the edge 330 is generally parallel to the article-surface; and the article is then so moved as to cause its surface to travel in a direction transverse to the edge 330. With an electrostatic field maintained between the lower edge of the liquid film and the article, such film-edge will be drawn into a series of cusps from the tips of which atomization will occur. The atomized material will leave each cusp tip in the form of a divergent jet, and the aggregate of all the jets from the cusp-tips will form a generally prismatic spray. If the article being coated is an extended flat sheet, such spray will produce a substantially rectangular pattern having rounded ends. It is not essential for the edge 330 to be horizontal or for the liquid film to be vertical, although it is desirable that the atomizer, if of conducting material, be so disposed as to avoid electrical shielding of the film-edge from which atomization is to take place.

Fig. 8 illustrates an atomizer which, like those of Figs. 1 and 5, produces an annular spray-pattern. It comprises a funnel-like or cone-shaped reservoir 410 whose annular wall is shown as decreasing in thickness toward an annular, narrow edge 411. At its apex, the conical reservoir is provided with an inlet opening 414 controlled by a valve 415.

The atomizer of Fig. 8 is especially suited for the coating of the bottom surfaces of sheets or other articles. In such use, it is disposed as shown with its edge 411 presented upwardly in opposed, spaced relation to the surface to be coated, which may be the lower surface of a horizontally moving sheet 416. Liquid coating material admitted to the reservoir through the opening 414 fills the conical recess, forming a concave meniscus which extends a short distance upwardly along the reservoir-wall to a point above the liquid level. Such meniscus constitutes, in effect, an annular film; and if the liquid level within the reservoir is so maintained as to keep such film at the edge 411 while a high difference of electrical potential is maintained between the film and the sheet 416, atomization from the film-edge will occur in much the same fashion as in the atomizer of Fig. 1.

Fig. 9 shows a coating apparatus which utilizes an atomizer such as that shown in Figs. 1 and 2, and which is adapted to coat the exteriors of cylindrical objects, such as metal canisters 508 and covers 509 therefor. This coating apparatus comprises an atomizer 510, supported in any suitable manner in the vertical position indicated and electrically connected to a voltage source 511. Spaced below the head 510 is a conveyor generally shown at 515, which includes a plurality of supports 516. Each support 516 is provided with a pair of spindles 517, each of which has mounted thereon a pulley 518. Each spindle 517 is adapted to support one of the articles to be coated. Rotating mechanisms, shown as belts 520, are provided on each side of the conveyor 515 for rotating the pulleys 518 and thereby the articles 508—509 in the direction indicated by the arrows.

In operation the conveyor 515 moves in the direction indicated by the arrow, to carry the articles 508—509 in two rows past the atomizer 510, which is disposed above and between such rows. The articles, which are conveniently grounded through the conveyor, approach and move past the head 510, which is maintained at elevated potential by virtue of its connection to the source 511. Coating material fed to the atomizer is atomized as above set forth to form a generally downwardly directed spray, and the particles forming such spray are electrostatically attracted to and deposited on the articles. The combined rotative and translational motion of the articles results in a satisfactorily uniform distribution of the coating material on their side and upper surfaces.

Fig. 10 shows another coating apparatus embodying an atomizer of the type shown in Fig. 1. In such apparatus, the atomizer 610 is so arranged with respect to a conveyor 611 that the articles to be coated, shown as circular trays 612, pass in a single column directly beneath it. The articles are carried on spindles 613 forming part of the conveyor; and such spindles may be rotated, as by mechanism 618—620 similar to that of Fig. 9, if such rotation is necessary to satisfactory uniformity of coating.

Fig. 11 shows a coating apparatus for coating the interior surfaces of articles which utilizes a head like the one illustrated in Fig. 5. This apparatus comprises a conveyor 710 which includes article supports 711 adapted to support articles such as the open-topped canisters 713. If desired, the supports 711 may be rotatable and provided with pulleys 714 engaged by a belt 715 to rotate the articles as they are being coated.

A frame structure 720 located at one side of the conveyor embodies rods 722 which extend parallel to the conveyor and provide a guiding support for a horizontally reciprocable carriage 725. Such carriage is urged along the rails 722 rearwardly, or in a direction counter to the direction of conveyor movement, by tension springs 728 and is arranged to be moved with the carriage in a forward direction by a rod 730 which is adapted to project from the carriage into the path of the supports 711. The rod 730 is mounted in the carriage for reciprocation longitudinally of itself and transversely of the direction of conveyor movement. A spring 732 urges the rod outwardly of the carriage toward a position in which it crosses the path of the supports 711. The rod is provided with an abutment 735 which, as the carriage nears the end of its movement with the conveyor, engages a stationary cam 736 at the side of the conveyor and is urged thereby inwardly of the carriage to free the end of the rod from engagement with the article-support 711. When this occurs, the carriage is returned to its starting point by the springs 728, and the spring 732 projects the rod into position for engagement by the next article support 711.

The atomizer 740, similar to that of Fig. 5, is supported through an insulating bracket 741 from the upper end of a rod 742 which is vertically reciprocable in guides 743 carried by the carriage 725. At its lower end, the rod 742 has rigid with it a spindle 744 which rotatably supports a cam follower 745 adapted to co-operate with a cam plate 746 stationarily secured to the frame 720. The cam plate 746 has two downwardly presented follower-engaged cam surfaces 747 and 748, the former sloping downwardly and the latter upwardly with respect to the direction of conveyor movement. Tension springs 750, acting between a plate 751 on the lower end of the

rod 742 and brackets 752 on the carriage 725, urge the rod upwardly.

As the carriage 725 reciprocates, the cam follower travels around the cam plate in a counterclockwise direction. During forward, or rightward, movement of the carriage the springs 750 hold the cam follower 745 against the cam surfaces 747 and 748, as a result of which the rod 742 is moved first downwardly and then upwardly. During rearward movement of the carriage, the cam follower 745 passes above the plate 746, the rod 742 being held in an upper position determined by engagement of the plate 751 with the lower rod-guide 743. As the carriage nears the rearward limit of its movement the follower 745 displaces and passes beneath a pivoted pawl 754 which returns to the position indicated in Fig. 11 after the follower 745 has cleared it. On the ensuing forward movement of the carriage, the cam follower engages the pawl, which provides, in effect, an upward continuation of the cam-surface 747 and hence serves to start the cam follower and the rod 742 on their downward movement.

The atomizer 740 is supplied with coating material through a flexible hose 755 under the control of a suitable valve (not shown) which may be similar to the valve 52 illustrated in Fig. 1. If such a valve is employed, it may be operated under remote control through the medium of a fluid-pressure motor 756 similar to that shown in Fig. 2. To provide the elevated electrical potential necessary to electrostatic atomization, the atomizer 740 may be made of conducting material and connected to the ungrounded terminal of a high-voltage source 757.

The insulating bracket 741 is so disposed relative to the rod 730 that when the latter is in engagement with an article-support 711 the atomizer 740 will be substantially coaxial with an article on such support. The bracket 741 is so disposed on the rod 742 that when the rod is in its upper position the atomizer will be positioned high enough to clear an advancing article 713. When in the movement of the conveyor such article comes directly beneath the atomizer, the support carrying it engages the rod 730 thus causing the carriage, as well as the atomizer 740 which is supported therefrom, to move with the conveyor and maintain the axial alignment of the atomizer and the article. As the carriage moves forwardly, the cam plate 746 first causes the atomizer to be lowered into the interior of the article 713 and then to be raised to its uppermost position above such article. As the upper position of the atomizer is attained, the abutment 735 on the rod 730 engages the cam 736, which acts to retract the rod until its end clears the support 711, whereupon the springs 728 retract the carriage to its starting point and the spring 732 advances the rod 730 for engagement by the next article-support. The supply of fluid to the atomizer and the potential of the atomizer are desirably automatically controlled, by mechanism hereinafter described, to cause the electrostatic atomization of coating material while the atomizer is within each article 713 but to shut off the supply of coating material and free the atomizer of its high potential when the atomizer is in its upper position.

To effect the automatic control just mentioned, the apparatus illustrated in Fig. 12 may be employed. As there shown, the voltage-source 747 comprises a step-up transformer 760 the secondary terminals of which are connected respectively to ground and to the filament-cathode of a thermionic rectifier 761 the anode of which is connected through a conductor 762 to the atomizer 740. Filament current for the rectifier 761 is provided by a step-down transformer 763 the primary of which, while the coating apparatus is in operation, is permanently connected to an alternating-current supply line 764. The primary of the transformer 760 is connected to the supply line 764 through switch contacts 765 of an electromagnetic switch embodying a winding 766. The electromagnetic switch embodies a second set of contacts 767 which control the supply of current from the supply line 764 to a solenoid 768 operating a fluid-pressure valve 769 which, in turn, controls the fluid-pressure motor 756 operating the coating-material valve associated with the atomizer 740. The winding 766 of the electromagnetic switch is connected to the supply line 764 through a normally closed switch 770 and a normally open switch 771, the latter being bridged by a holding circuit 772 including a third set of contacts 773 of the electromagnetic switch. All contacts of the electromagnetic switch are biased toward open positions, and are adapted to be closed when the winding 766 is energized. The switches 771 and 770 (see Fig. 11) are of the mechanically actuatable type, are disposed adjacent the respective upper ends of the cam surfaces 747 and 748 of the cam plate 746, and have actuating members which project into the path of the cam-follower spindle 744 so that such spindle, as it passes each switch, will momentarily reverse its normal condition.

The apparatus as illustrated in Fig. 11 and Fig. 12 in the condition existing when the atomizer is at an intermediate point in its vertical travel within an article 713. In this condition, current from the supply line 764 is being supplied to the winding 766 of the electromagnetic switch through the closed switch 770, the contacts 773 of the electromagnetic switch, and the holding circuit 772. As a result of the energization of the winding 766, the contacts 767 are closed to energize the solenoid 768 and the contacts 765 are closed to energize the high-voltage transformer 760. Energization of the solenoid 768 operates the valve 769 to admit fluid under pressure to the motor 756, thus opening the valve which controls the supply of coating material to the atomizer 740. The closed condition of the contacts 765 results in the supply of current to the transformer 760 and in the imposition of its rectified output upon the body of the atomizer 740. On consequence of these conditions, the coating material is being supplied to the atomizer to be electrostatically atomized therefrom and electrostatically deposited over the inner surface of the article 713 within which the atomizer is disposed.

As the carriage 725 continues its forward movement, the cam follower moves upwardly along the cam surface 748, and its spindle 744 eventually engages the operating element of the switch 770 to open such switch momentarily. When this event occurs, the supply of current to the winding 766 is interrupted, such winding is deenergized, and the contacts 765, 767, and 773 all opened to deenergize the transformer 760, to deenergize the solenoid 768, and to open the holding circuit 772. Deenergization of the transformer 760 interrupts the supply of high potential to the atomizer 740, while deenergization of the solenoid 768 operates the valve 769 to cause the fluid-pressure motor 756 to shut off the supply of coating material to the atomizer. As a result, electrostatic atomization ceases. Following retraction of the rod 730 by the cam 736, the carriage 725 returns to its rearmost position under the influence of the springs 728 as above described. When the next article support 711 engages the rod 730, the carriage begins another forward movement, the cam follower 745 first engages the pawl 754 and then the cam surface 747 to lower the atomizer 740 into the interior of the article on such next support 711. As the atomizer enters the interior of such article, the spindle 744 engages and momentarily closes the switch 771 to complete the circuit from the supply line 764 through the winding 766. The resultant energization of such winding closes the contacts 765, 767, and 773 to energize the high-voltage transformer 760, to energize the solenoid 768, and to complete the holding circuit 772 through which the winding 766 is kept energized when the switch 771 opens

as the spindle 744 moves out of association with it. The energization of the transformer 760 and of the solenoid 768 institutes electrostatic atomization and precipitation which continue until the cam follower 745 opens the switch 770 in upward movement of the rod 742 and atomizer 740, as above set forth.

By an obvious relocation of the switches 770 and 771, the apparatus of Figs. 11 and 12 could be arranged to cause the atomizer 740 to discharge either on its down-stroke only or on its up-stroke only. It is not essential that the application of high potential to the atomizer begin and terminate sumultansously with the opening and closing of the valve which controls the supply of coating material to the atomizer.

In all the various different forms of atomizers described above, the liquid to be atomized flows in the form of a film to the site of atomization, where an electrostatic field is maintained over the leading edge of the film. The film is relatively thin, having a thickness which is but a small fraction of its extent in the other direction transverse to its direction of flow. As above noted, the field draws the leading film-edge into a series of cusps from the tips of which atomization takes place, the atomized particles leaving each cusp-tip in the form of a divergent jet and the aggregate of such jets constituting the spray. The spacing of the cusps depends to a large extent upon field strength; and in coating operations, the field strength will depend upon the distance and potential difference maintained between the leading edge of the film and the article being coated. In general, the spacing of the cusps will decrease as the field-strength increases; and it is therefore possible in most instances to so space the cusps that, at the article-surface, the individual divergent jets will approach each other so closely as to prevent the existence of any substantial voids or discontinuities in the deposited pattern. It has been found, however, that if the distance between the atomizer and the article is decreased, difficulty is experienced in preventing discontinuities in the deposited pattern of coating material. As the distance between the atomizer and the article decreases, less and less distance remains between the cusp-tips and the article surface, and eventually a condition is reached in which such distance becomes so small that the particles leaving each cusp-tip become deposited before they have an opportunity to disperse to the extent necessary to form a pattern substantially continuous with the pattern formed by particles from adjacent cusp-tips. If the gap is not too narrow such condition can frequently be remedied by increasing the applied voltage to decrease cusp-spacing; but at narrower gaps, the break-down voltage may be obtained before discontinuities in the pattern are eliminated, Sometimes, at narrow gaps, the cusp-tips will bridge the gap and touch the article, and no dispersion at all will occur. In general, it is impractical to attempt the production of a continuous coating at gaps much less than one quarter-inch in width. My invention contemplates that the gap between the atomizer and article will be great enough to insure the dispersion necessary to production of a continuous coating. In no case will the gap be narrow enough to permit coating material supported on the atomizer to bridge the gap to the article; and in the preferred mode of practicing the invention, the cusp-tips will be materially farther from the article than they are from the nearest point on the film-supportinug surface of the atomizer. Also, the spacing between adjacent cusp-tips will be less than their distance from the article. In practice, it has been found convenient in many instances to maintain a distance on the order of ten inches between article and atomizer, at which distance a potential difference of 100,000 volts will effect satisfactory atomization, dispersion, and precipitation.

As a specific application of my invention, I cite the coating of covered metal canisters with apparatus like that shown in Fig. 9 embodying an atomizer of the type shown in Figs. 1 and 2. In that application, the following conditions obtained:

| | |
|---|---|
| Potential of discharge edge 47 | 100,000 volts negative). |
| Potential of article being coated | Ground potential. |
| Spacing between atomizer and the closest surface of canisters | 8 inches–10 inches. |
| Longitudinal spacing of rotating spindles 517 | 18 inches. |
| Transverse spacing of spindles 517 | 12 inches. |
| Diameter of canisters | 3 inches–7 inches. |
| Height of canisters | 6 inches–10 inches. |
| Width of passage 32 | .002 to .005 inch. |
| Diameter of discharge edge 47 | 1.5 inches. |
| Form of discharge edge 47 | Knife edge between two smoothly ground surfaces whose included angle is 15°. |
| Liquid coating material | Synthetic enamel, modified urea formaldehyde, 20 sec. viscosity on Zahn #2 cup at 75° F. |

Under the conditions above set forth, the spacing of the cusps of coating material which formed on the discharge edge was of the order of fifty to the inch. Cusp form and spacing depend upon the viscosity and conductivity of the liquid, and upon the rate of liquid supply, as well as upon field strength. Liquids with high insulating properties, such as transformer oil, do not form well-defined cusps. Viscous liquids tend to form greatly elongated cusps which tend to break up into filament-like segments rather than into fine drops.

The voltage-source used in the above example provided half-wave rectification with some inherent filtering; but satisfactory coatings can be obtained with unrectified A.C. In general, steadiness of the potential applied to the head promotes fineness of atomization and decreases scattering of the atomized particles. The effectiveness of the electrostatic field in causing atomization and deposition of atomized material will vary in the same sense as the applied voltage, and it is therefore desirable in most instances to use the highest voltage consistent with freedom from possible sparking. Voltages which create between the atomizer and article an average potential gradient of 8,000 to 12,000 volts per inch are very satisfactory.

The invention can be practiced without regard to the polarity of the potential maintained on the leading edge of the liquid film. In coating apparatus using a ground return, either the atomizer or the article can be connected to the voltage-source through ground; but in most instances it will be more convenient to ground the article. In order to maintain an effective field, the charges carried by the deposited particles must escape through the article. Most materials, including many usually thought of as insulators, are sufficiently conductive to permit the escape of charges even over paths of considerable length but in coating an article made of one of the more effective insulating materials, it may be desirable to use a backing electrode or some other expedient to shorten the escape-path.

It is not essential that the atomizer, or even that portion of it which supports the film, be made of conducting material. Most liquids, and especially most coating materials, are sufficiently conducting that if the atomizer is made of insulating material the potential can be applied to the film-edge through the film itself. Moreover, the current consumed in the atomizing operation is so small that it can be conducted to the discharge edge of the atomizer through materials of relatively high insulating properties.

I have referred above to the fact that fine atomization is promoted by the employment in the atomizer of sharp-edged film-supporting elements. Where fine atomization is of no moment, or undesired, the shape of the film-supporting element in cross-section transverse to its extent is of little consequence. If the atomizer of Fig. 1 is modified by rounding the edge 47 on a radius of 0.005 inch, no significant change in the fineness of atomization results. An edge rounded on a small radius has

an advantage in reducing danger of injury to personnel and also in reducing danger of injury to the edge itself. Discontinuity of the edge, such as would result from a nick therein, might interfere with the uniform distribution of liquid therealong. Where deposition of an extended film of coating material free from discontinuities is desired, the edge itself should be free from abrupt discontinuities; although discontinuities or irregularities whose dimensions are smaller than the spacing of the cusps are not objectionable.

In addition to the cross-sectional shape of the film-supporting element of the atomizer the applied voltage and the rate of liquid flow influence the fineness of atomization. Increasing the applied voltage tends to increase the fineness of atomization, while an increase in the rate of fluid supply tends to decrease it. Obviously, the liquid should not flow to the film-edge at a rate greater than that at which the field will atomize it. The amount of liquid which can be atomized with any desired degree of fineness from an atomizer will of course depend upon the total length of the film-supporting element of the atomizer.

It will be understood of course that the stippled showing in Fig. 13 represents the pattern created in a brief interval of time. The disposition of deposited particles is largely haphazard within the borders of the pattern; and as the spraying is continued, the individually deposited particles of liquid coating material flow together to form a coating which, except at its edges, is entirely continuous. By producing relative movement of the spray and the article in a direction generally transverse to the lines of force of the field, a continuous coating over the entire surface of the article may be produced.

It will also be understood that the pattern shown in Fig. 13 is that created on a substantially flat surface of considerable extent relative to the distance between the atomizer and the surface. The shape of the field—that is, the dimensional pattern represented by all the lines of force—will depend upon the shape of the article. The divergence of the liquid spray will generally decrease as the article is approached, and in many instances the spray will actually be convergent at the article-surface.

Any of the atomizers can be used otherwise than in the application of liquid coatings. In such case, the atomizers may be supported spaced from grounded objects and connected to one terminal of a high-voltage source the other terminal of which is grounded. In such use, the potential applied should be at least 10,000 volts, and it is unnecessary to provide any electrode in spaced relation to the atomizer and of opposite polarity thereto. By providing such an opposed electrode, however, and raising it to a sufficient potential, atomization can be effected even with the atomizer grounded. In the latter case, the opposed electrode will be spaced from the cusp-tips far enough to permit the particles atomized from such cusp-tips to disperse.

In coating apparatus, it is desirable to arrange the atomizer so that the spacing between the leading edge of the film and the article surface will be as uniform as possible throughout the extent of such film-edge, as such an arrangement promotes uniformity of field-strength and of atomization along the film edge. In the coating of contoured surfaces, it is frequently of advantage to employ an atomizer embodying a film-supporting member having an edge shaped to be spaced uniformly from such surface. It is for this reason that the atomizer of Fig. 5 is especially suited for coating concave cylindrical surfaces, as in Fig. 11; for the distance between the edge of the film-supporting flange 231 and the inner surface of the canister 713 may be made uniform throughout the circumference of the edge of such flange. Atomizers like that of Fig. 1, when used as in Figs. 9 and 10 to coat articles moving successively past them, are desirably oriented so that the plane of the cusp-tips is substantially parallel to the path of article movement.

The specific embodiments of my invention illustrated and described herein are set forth merely as examples of a few of the many ways in which the invention can be practiced, and it is therefore to be understood that the scope of my invention is not to be limited by those examples but instead is to be determined from the appended claims.

I claim as my invention:

1. A method of electrostatically distributing liquids as a coating on an article, comprising the steps of flowing a stream of liquid coating material from a supply source including an orifice and positively deforming it into a thin annular flowing film, advanced without subdivision along a supporting surface to an atomizing zone to provide a thin circular film edge substantially spaced from the article and having an extent many times its thickness and many times the minimum dimension of said orifice, the material being uniformly distributed along the entire extent of said edge and projecting beyond said supporting surface, creating between the article and the leading edge of such film an electrical potential creating an electrostatic field of sufficient strength to form such leading edge into a series of spaced cusps, to affect the spacing of said cusps and to electrostatically atomize, disperse and deposit on said article while still in liquid state finely divided particles of liquid from the tips of such cusps, the cusps being so closely spaced as to provide a substantially continuous atomizing zone and the distance between the article and the atomizing zone being great enough to permit substantial dispersion of the liquid spray particles as they proceed toward the article, the atmosphere at the article and between it and the atomizing zone being quiescent whereby electrostatic forces will effect deposition on the article of a substantial number of particles which otherwise would not have been deposited thereon, and supplying additional coating material to said film in rear of its leading edge to maintain the flow of the film to such leading edge.

2. A method of electrostatically distributing liquid as a coating on an article, comprising the steps of flowing a stream of liquid coating material from a supply orifice and positively deforming it into a thin film advanced without subdivision from the orifice to an atomizing zone to provide a thin film edge substantially spaced from the article and having an extent many times its thickness, creating between said film edge and said article an electrostatic field of sufficient strength to form and affect the spacing of cusps at said edge and to electrostatically atomize finely divided discrete particles of liquid as a spray from the edge of said film at said zone, supplying said film with liquid at a controlled rate to replace that so atomized, and electrostatically dispersing said particles and depositing them still as discrete liquid spray particles on the article, the distance between the article and the atomizing zone being great enough to permit substantial dispersion of the liquid spray particles as they proceed toward the article, the atmosphere at the article being quiescent whereby electrostatic forces will effect deposition on the article of a substantial number of particles which otherwise would not have been deposited thereon.

3. In a method of electrostatically spray coating the surface of an article with liquid atomized from an extended atomizing zone, the steps of flowing liquid coating material at a controlled rate from a source of supply, forming it into a thin supported film, advancing said supported film toward said atomizing zone, said film having a uniform edge extending along said atomizing zone for a distance many times its thickness, establishing between said film-edge and said article an electrostatic field of sufficient strength to form said film-edge into a series of spaced cusps and to electrostatically atomize finely divided discrete particles of liquid as a spray from said cusps, said film edge being sufficiently uniform to permit

said field to determine the spacing of said cusps, and electrostatically dispersing and depositing said particles on the article surface while still in liquid state, said article surface being in a substantially quiescent atmosphere and at a distance from said atomizing zone sufficient to permit substantial dispersion of the liquid spray particles as they proceed toward the article.

4. The method of claim 3, further characterized in that said film-edge is substantially rectilinear.

5. The method of claim 3, further characterized in that the film-edge is a circle.

6. The method of claim 3, further characterized in that the film-edge is generally arcuate.

7. The method of claim 3, further characterized in that the atomizing zone is annular and the article to be coated moves along a predetermined path intersecting the projected axis of the atomizing zone whereby the atomized particles will move generally axially of said zone as they proceed toward the article surface.

8. The method of claim 3, further characterized in that said film-edge is arcuate and the article surface to be coated is spaced outwardly from the film-edge in the plane thereof whereby the atomized particles will move generally in such plane as they proceed toward the article surface.

9. Apparatus for electrostatically spray coating the surface of an article with liquid atomized from an extended atomizing zone, comprising an atomizing head, means for delivering liquid coating material at a controlled rate from a source of supply to said head, said head including means for forming said liquid into a thin supported film and for providing said film with a substantially uniform leading edge extending along the atomizing zone, means for establishing between said film-edge and said article an electrostatic field of sufficient strength to draw the liquid of the film-edge beyond its support and form said film-edge into a series of spaced cusps, to electrostatically atomize said liquid from said cusps into a spray of finely divided discrete particles, and to disperse and deposit said particles on the article surface while still in liquid state, and means for positioning the article surface at a distance from the atomizing zone to permit substantial dispersion of liquid spray particles through a quiescent atmosphere as they proceed toward the article surface.

10. Apparatus of the character claimed in claim 9, further characterized in that said film-forming means includes a surface provided on said head and having a margin extending along said atomizing zone, said means for delivering liquid coating material discharging such material onto said surface in rear of said margin for flow over said surface as a free-surfaced film to the atomizing zone.

11. Apparatus for electrostatically spray-coating an article by depositing thereon discrete spray particles, comprising a support for the article, an applicator head providing an extended atomizing zone spaced from the article on said support, passage means for delivering liquid coating material to said head at a positively regulated rate, said head having an elongated orifice communicating with said passage means and provided by opposed closely spaced flow-controlling confronting surface portions for forming said material into a thin film and for delivering the film to said atomizing zone, said article-support and head being so spaced that the shortest distance between the atomizing zone and the article on said support is many times greater than the diameter of a drop of the liquid coating material, means including a high voltage source for providing electrostatic charge differentials between the surface of the article and atomized particles of sufficient strength both to disperse the charged spray particles into a condition of substantially uniform distribution relative to the extended atomizing zone and to draw the charged spray particles rapidly through quiescent air generally along the lines of force of the field to an adjacent article surface, and means for moving said support and article past said head throughout a substantial distance during particle deposition in unvarying relationship to each other, the direction of movement of said support relative to said head being such as to effect a substantial displacement of the article surface transverse to the general direction of said lines of force during particle deposition to cause such lines of force to sweep such article surface, said atomizing zone having an extent many times the minimum dimension of said orifice.

12. Apparatus of the character claimed in claim 11, further characterized in that the confronting surface-portions have generally arcuate, closely spaced edges providing a generally arcuate atomizing zone of substantial extent.

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METHOD AND APPARATUS FOR ELECTROSTATICALLY COATING

Original Filed Feb. 13, 1950 2 Sheets-Sheet 1

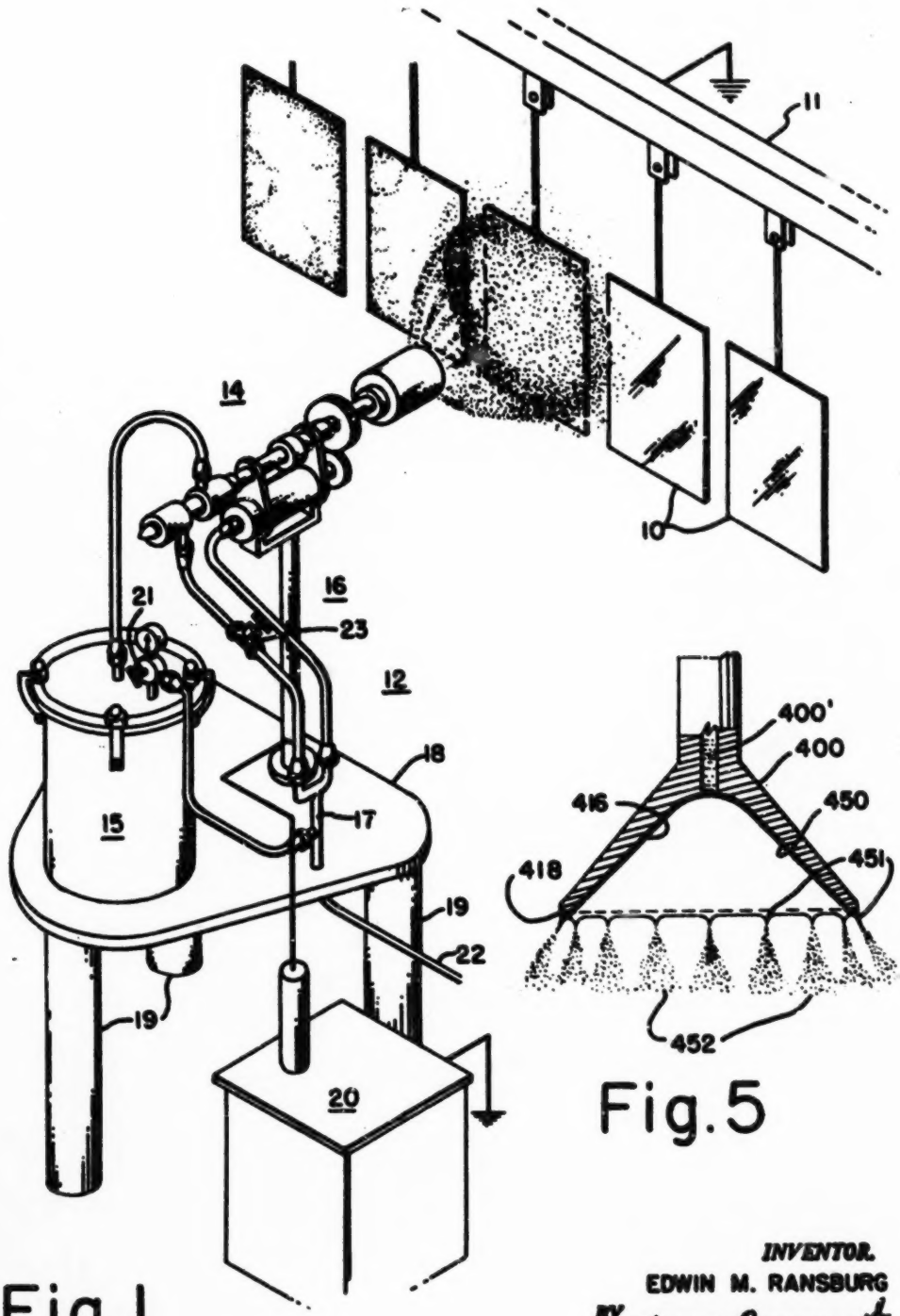


Fig. 1




Fig. 5

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METHOD AND APPARATUS FOR ELECTROSTATICALLY COATING

Original Filed Feb. 13, 1950 2 Sheets-Sheet 2

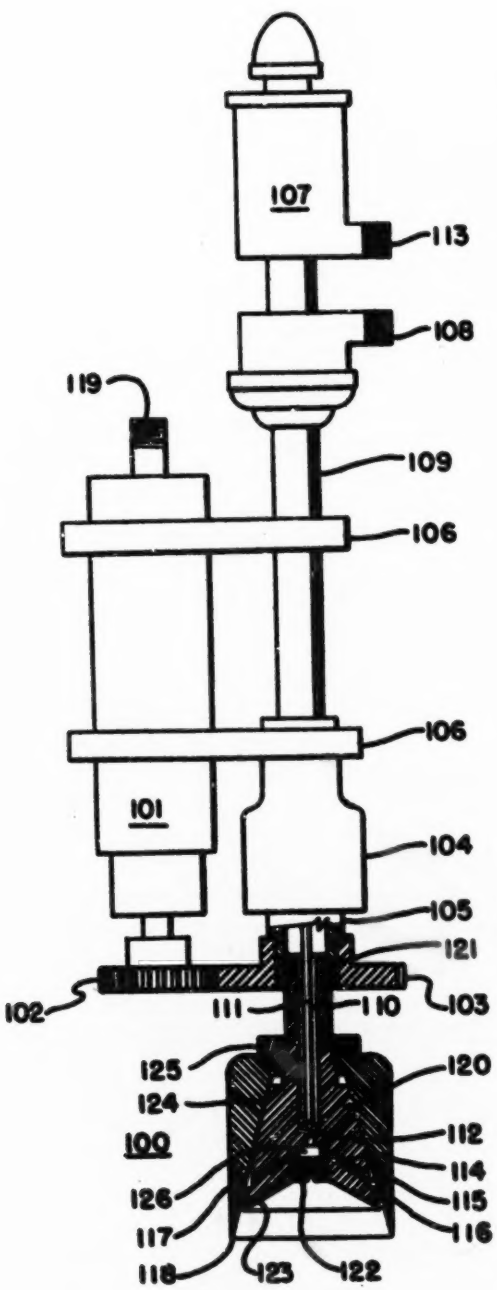


Fig. 2

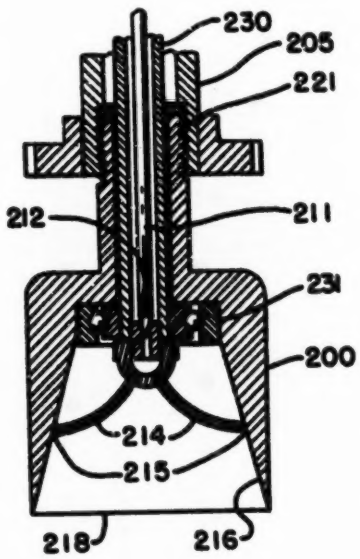


Fig. 3

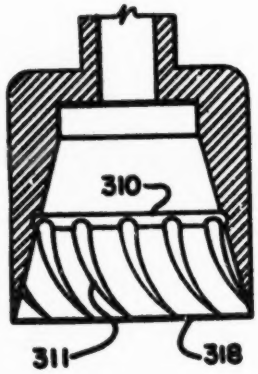


Fig. 4

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# METHOD AND APPARATUS FOR ELECTROSTATICALLY COATING

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Continuation of application Serial No. 143,994, February 13, 1950. This application November 3, 1958, Serial No. 771,585

8 Claims. (Cl. 117—93)

This invention relates to methods for electrostatically applying liquid coating materials and to apparatus suitable for use in practicing such methods. More particularly, the invention relates to electrostatic coating methods in which liquid coating material is both atomized from a series of spaced points under the influence of an electrostatic field and electrostatically precipitated upon surfaces to be coated and to improved apparatus for effecting the electrostatic atomization.

In the copending application of W. W. Crouse, Serial No. 141,509, filed January 31, 1950, there are disclosed methods and apparatus employing electrostatic atomization and electrostatic precipitation of liquid coating material. The invention of that copending application contemplates that the liquid coating material will be fed to the site of atomization in the form of an extended, thin film between the leading edge of which and the surface to be coated an electrostatic field is maintained, such field serving to deform the leading film-edge into a series of cusps, to atomize finely divided particles of the coating material from the tips of such cusps, and to deposit the atomized particles upon said surface. In certain embodiments, the present invention utilizes the broader invention of the aforesaid copending application and constitutes an improvement upon it.

It is an object of the present invention to improve and to make more uniform the distribution of deposited coating material which has been atomized from a series of spaced points. A further object of the invention is to provide a method and apparatus by which it is possible to counteract any tendency of gravity or other influences to produce disuniformity in the distribution of electrostatically atomized liquid coating material within the pattern of the spray emanating from the atomizer. Still another object of the present invention is to produce an electrostatic atomizing apparatus which will provide a satisfactorily uniform distribution of liquid coating material within the spray pattern while permitting the atomizer to be made with greater manufacturing tolerances than are possible in the atomizer of the aforesaid copending application.

In carrying out the invention in its preferred form, the leading edge of an extended, thin film of liquid coating material is presented in spaced relation to the surface to be coated and an electrostatic field is created between such film-edge and surface, as in the aforesaid prior application; but in the present instance I cause the liquid cusps, from the tips of which atomization takes place, to move as a group transversely of the lines of force of the electrostatic field. Such movement is along the line occupied by the cusps and hence, although it does not alter the general shape of the spray formed by the material atomized from all the cusps tips, it does tend to promote uniformity of coating-material distribution within the boundaries of such spray. In the specific embodiments of the invention herein described, the liquid film is annular, the cusps lie on a circle, and cusp-movement is produced by rotating the film-supporting atomizer about



the film axis; but equally within the scope of my invention in its broader aspects are atomizers, such as the one shown in the copending application of Emery P. Miller, Serial No. 150,713 (now Patent No. 2,718,477), embodying other forms of movable, film-supporting elements, and atomizers, such as are shown in my own copending application Serial No. 107,687 (now Patent No. 2,684,656), in which cusp-movement may occur although the film-support remains stationary.

The manner in which these and other objects and advantages of the invention are realized will be described in connection with the accompanying drawings.

Fig. 1 is an isometric, somewhat schematic view of a complete coating apparatus;

Fig. 2 is an elevation, partly in section, of the applicator means shown in Fig. 1;

Fig. 3 is an axial section of a modified form of atomizer;

Fig. 4 is a fragmental sectional view showing a further modification; and

Fig. 5 is an axial section showing still another modification.

For the purposes of illustrating this invention as employed in a method of and apparatus for applying liquid coatings, there is shown in Fig. 1 a form of apparatus adapted for coating discrete articles, such as the flat, extended plates shown. The articles 10 to be coated are supported from an overhead conveyor 11 which is so arranged as to carry the articles past and in spaced relation to the apparatus generally indicated at 12.

That apparatus comprises applicator means 14, coating material supply tank 15, applicator-means support 16 and air supply lines 17, which are all supported on platform 18 that is electrically insulated from ground by insulating supports 19. Air supply line 17 is connected externally by means of an insulating rubber hose 22 to a source of air under pressure, not shown.

The applicator means 14, shown in detail in Fig. 2, comprises atomizer 100, air drive motor 101, drive gears 102 and 103, fluid-conveying coupling embodying stationary and rotatable members 104 and 105, alignment blocks 106, and air operated valve-motor 107. In use, coating material under pressure delivered to connection 108 flows through connecting tube 109, through rotating fluid coupling 104—105 and into the top of the atomizer 100 at passage 110. Needle 111, which is operatively connected to the valve-motor 107 blocks the further flow of the coating material into the head by being seated in orifice 112.

When air pressure is applied to connection 113, the valve-motor 107 operates to lift needle 111 from orifice 112 allowing coating material to flow into central chamber 126 and radial passages 114. Coating material is thus circumferentially distributed about annular channel 115 from which it flows by way of the narrow annular slit 116 to the inner surface of external member 117. It is thus distributed on that surface and will flow to the extended annular edge 118, which edge is desirably sharpened as shown or otherwise attenuated.

The particular atomizer shown in this modification of the present invention is constructed of a central body section 120, arranged at its upper end to screw into the rotatable coupling member 105 as at 121 and centrally drilled from the upper end to orifice 112 in order to receive needle 111 and still permit passage of material to orifice 112. A plug 122 immediately below orifice 112 provides a ready means of cleaning the orifice and the associated chamber 126 and passages 114. Externally, the central body section 120 is machined with two coaxial tapers 123 and 124, the former offset inwardly from the latter by the desired thickness of slit 116. Taper 124 fits into the internal taper of part 117, insuring that

this part is centrally positioned, that a liquid-tight seal is formed above channel 115, and that slit 116 will be uniform in width within the accuracy of the machining process. External member 117 is held in place on the internal member by means of nut 125. In this embodiment, the external member 117 is made of electrical conducting material, although insulating materials may be effectively used especially where the coating material being applied is electrically conducting to the same extent as the commonly used synthetic enamels.

By applying air pressure to orifice 119, air motor 101 is caused to rotate and drive gears 102 and 103, thus causing atomizer 100 to rotate in the bearing afforded by coupling member 104. The extended edge 118 is thus moved longitudinally of itself in a cyclic manner.

In practicing this invention, the applicator means shown in detail in Fig. 2 and described above may be placed as shown in Fig. 1 on its support stand 16, and the entire assembly supported on stand 18, which is electrically insulated from ground. The extended edge 118 of the atomizer is arranged in spaced relation to the articles 10 to be coated, supply tank 15 containing the liquid coating material to be applied to the surfaces of articles 10 is also supported on platform 18 and connected to air line 17 so that air pressure can be applied to force the coating material from the tank in a regulatable manner to the connection 108 of the applicator means and thence as described above to the extended edge 118 of the atomizer. Regulation of this pressure and hence of the rate of flow of material to the edge is accomplished by regulator 21.

Air line 17 is also connected to connection 113 of the valve-motor 107 so that needle valve 111 can be opened and closed as desired by the application or release of pressure. Line 17 is also connected to connection 119 of the air motor so the atomizer can be rotated. In the conduit leading from line 17 to connection 113, there is located an adjustable air valve 23. By appropriately setting the valve 23, the rotation of the atomizer 100 can be started at any desired time in advance of the withdrawal of needle 111 and the consequent flow of material to the atomizer. It is to be understood that means other than air could be used to withdraw the fluid needle and to rotate the atomizing head in place of the air devices shown.

One side of a high voltage source 20 is electrically connected to the atomizer, and the other side of this same source is connected to ground and through it by way of the grounded conveyor and article supports to the grounded surfaces to be coated. This source when electrically energized thus serves to establish an electric field between the continuous extended edge of the atomizer and the surface being coated. The air line connection to pipe 17 from a suitable grounded compressor is made by means of a hose of rubber or other insulating material, so that it will not interfere with holding the platform 18 at high potential with respect to ground. Appropriate air valves and electrical controls (not shown) permit the application of the high voltage and the air pressure as desired from a remote position by an operator at ground potential.

The liquid supplied to the atomizer 100 when the valve 111 is opened passes as an annular film through the annular slit 116. Escaping confinement at the lower edge of the surface 123, the liquid flows as a free-surfaced film over the inner surface of the external member 117 to the annular edge 118 where it becomes exposed to the action of the electrostatic field above described. As set forth in copending application Serial No. 141,509, the field acts to deform the leading edge of such liquid film into an annular series of spaced cusps from the tips of which finely divided liquid particles are atomized. The finely divided particles leave each cusp-tip as a narrowly divergent conical jet, and the aggregate of the jets from all the cusp-tips forms a hollow, generally frusto-conical spray which will be deposited in annular pattern on any extended, plane surface normal to the spray-axis. As the aforesaid copending application brings out, if liquid is supplied at a uniform rate to all points on the atomizing edge 118 and if the strength of the electrostatic field is uniform along such edge, the cusps into which the film is formed will be spaced at equal angular intervals about the axis of the atomizer. The spacing of the cusps will depend upon the strength of the electrostatic field, decreasing as field-strength increases.



Rotation of the atomizer 100 about its axis, which is the principal feature distinguishing the atomizers of this application from those specifically disclosed in the aforesaid copending application, has several important results. If the atomizer is disposed otherwise than with the edge 118 in a horizontal plane, rotation of the atomizer counteracts the effect of gravity in tending to produce an accumulation of coating material at and near the lowest point of such edge. If the inner surface of member 117 and the surface 123 are not accurately concentric, so that the film discharged through the slit 116 will not be of uniform thickness, the action of centrifugal force on the free-surfaced portion of such film lying outwardly beyond the slit 116 will promote uniformity of film thickness and uniformity of the rate at which coating material is supplied to all points of the edge 118. The same is true if the passage 116 should become occluded at one or more points of its circumference. By rotating the atomizer at an appropriate speed, it may even be disposed with its axis horizontal, as in Fig. 1, and no significant disuniformity in the distribution of coating material over the extent of the edge 118, and no significant disuniformity of distribution of atomized coating material within the limits of the spray, will result.

Rotation of the atomizer is also of advantage in that it destroys any lobal character of the deposited pattern which might result from the fact that atomization occurs at a plurality of spaced points rather than continuously along a line.

Another form of atomizer which can be used to practice this invention is shown in Fig. 3. In that modification, an atomizer-body 200, provided with threads 221 which attach it to a rotatable sleeve 205, has an annular atomizing edge 218. The coating material comes directly from orifice 108 (Fig. 2) by way of stationary tube 230, which passes axially through rotatable sleeve 205 into the atomizer-body 200 which is rotatably supported from it through bearing 231. Seat 212 at lower end of tube 230, in cooperation with needle 211, is arranged to regulate the flow of liquid material through tube 230 to distributor tubes 214. Distributor tubes 214, which are rigid with the lower end of supply tube 230 and hence stationary, terminate in openings 215 disposed to discharge, preferably with a wiping action, on to the inner wall 216 of head 200. As such head rotates, the material discharged from the openings 215 forms a free-surfaced film flowing toward the edge 218 over the wall 216, which flares toward such edge so that centrifugal force will promote feeding of the film.

This type of head has the advantage that a rotating, fluid-conveying coupling is not needed and hence the head is more freely rotatable. The diameter of the fluid openings 215 can be larger than the width of the restricting orifice 116 of the head shown in Fig. 2, and those openings will therefore not be as readily subject to stoppages by foreign matter in the coating material. To the extent that in the head of Fig. 3 the coating material is supplied to the wall 216 at one or more isolated points and distributed along the edge 218 by relative movement of the head-body and the orifice or orifices 215, such head embodies the invention broadly claimed in my application Serial No. 57,260, now Patent No. 2,658,472, granted November 10, 1953.

Although the atomizer of Fig. 3 is shown as having a smooth inner surface 216 over which the material flows from orifices 215 to edge 218, it has been found that

advantage can sometimes be gained by providing this surface with a series of spiral grooves which are inclined toward the atomizing edge and rearwardly with reference to the direction of atomizer-rotation. Such a grooved atomizer, in Fig. 4, has a circumferential groove 310 about the head at the level of the orifices 215, and spiral grooves 311 of progressively decreasing depth extend from that groove to the edge 318 where they vanish. Coating material discharged from the orifices 215 is urged outward and edgeward in the spiral grooves by reason of its inertia as the atomizer rotates, and is thus fed to the edge 318 for atomization. It is understood that other shapes and arrangements of grooves could be used for this purpose without departing from the scope of the invention.

The atomizer shown in Fig. 5 comprises a body 400 adapted to be supported in any convenient manner for rotation about its axis and provided in its lower end with a recess the wall 416 of which is of a generally conical form coaxial with the body 400. A feed passage 400' communicates with the apex of the conical recess. If liquid is fed through the passage 400' while the atomizer is rotated, the liquid will distribute itself in the form of a free-surfaced film 450 over the surface 416 and will flow to the edge 418; and if it there becomes exposed to the action of an electrostatic field of adequate strength, it will be electrostatically atomized in the manner above set forth. The atomizer of Fig. 5, like the other atomizers described, can be disposed with its axis at any angle to the vertical; but if it is disposed with its axis displaced from the vertical, its speed of rotation should be such that centrifugal force, acting on the free-surfaced liquid film, will effectively counteract the effect of gravity on the distribution of the liquid within the film.

The apparatus shown in Fig. 1 has been successfully used to apply synthetic enamels to vertically extending surfaces such as those illustrated. In operation, an atomizer three inches in diameter was supported at a distance of approximately eight inches from the surfaces to be coated. A voltage of approximately 75,000 volts supplied by a half-wave, tube rectified, transformer-driven unit was used to produce the atomization and precipitation of the material, while the head was rotated at approximately 150 revolutions per minute.

Although the apparatus of Fig. 1 is shown being used to coat vertical surfaces, it is to be understood that it can be applied equally well to the coating of horizontal surfaces or surfaces otherwise oriented, or to the coating of articles having surfaces oriented at various angles. The apparatus can be used equally well to coat continuous sheet material. In that case, the sheet may be unrolled from a suitable storage reel and carried past in spaced relation to the atomizer and thence to some drying or baking apparatus.

It is likewise to be understood that other diameter atomizers, other voltages, and other spacings between the atomizer and the surface or surfaces to be coated can be used without departing from the spirit of this invention. It is also possible to obtain satisfactory results with the apparatus when the surfaces being coated are electrically charged and the atomizer is grounded. Most liquids are sufficiently conductive that if the atomizer is made of insulating material the potential can be applied to the film-edge through the film itself.

In the atomizers of Figs. 2, 3, and 4, the edge (118, 218, or 318) from which atomization takes place is shown as knife-like in cross-section. Such knife-like form, while it facilitates the obtaining of fine atomization, is not essential. As a matter of fact, I prefer an edge rounded at a small radius, say at a radius at about 0.005 inch, as such an edge is less dangerous to personnel and less apt to be damaged, while the atomization obtained from it is not significantly coarser than is that obtainable from an edge of true knife-like character. If maximum fineness of atomization is deemed unnecessary, the edge from which atomization takes place may blunt, as indicated at 418 in Fig. 5. The atomizer sho of course be so shaped exteriorly and so disposed a reduce electrical shielding of the leading film-edge. order to promote uniformity of field-strength along atomizer-edge 118, 218, 318, or 418, the atomizer sho be so disposed that such edge is generally parallel to surface being coated. Where the atomizer is used the coating of a succession of articles moved past it a predetermined path, the atomizer edge is desirably posed parallel to such path.

Fig. 5, in addition to illustrating a blunt edge also indicates the manner in which the field deforms film-edge. This showing may be regarded as typical the action of the field in any of the other atomizers ill trated. The cusps formed by the field at the edge of film are indicated at 451, and the individual jets ema ing from each cusp-tip are shown at 452. The sm number of cusps 451 illustrated in Fig. 5 would o narily exist only at relatively low field strengths. In specific example set forth above, cusp-spacing was ab thirty to the inch. Wide cusp-spacing is promoted high viscosity of the liquid and by high rates of liq supply, as well as by low field-strengths.

I have indicated above that voltage and spacing tween the atomizer and articles being coated may v from the values set forth in the specific example scribed. In general, the potential maintained between atomizer and the articles being coated should be as h as possible consistent with freedom from possible spa ing; for high potentials effect finer atomization and mit higher outputs of atomized liquid. In practice prefer to employ potentials which will result in the istence between the atomizer and the article of an av age potential gradient in the neighborhood of 10,0 volts per inch, but materially lower potential gradie can be used if desired.

The invention herein described is applicable to coating of articles irrespective of the electrical c ductivity of the material from which those articles made. In the case of articles made of materials pos ing exceptionally high insulating properties, a back electrode or some other expedient may be necessary obtain satisfactorily uniform distribution of the deposi coating material; but many materials ordinarily thou of as insulators possess sufficient conductivity, either o their surface or otherwise, that no backing electrod necessary.

In some types of coating apparatus, as for exam that shown in Fig. 11 in the prior Crouse applicat above mentioned, the atomizer is bodily moved dur the coating process in order to permit the applicat of coating material to surfaces having an extent grea than that of the spray which the atomizer produ The present invention is adapted for embodiment in s apparatus; but when so embodied the liquid film, the cusps at its leading edge, will possess a motion addition to that previously mentioned. According when in the above description and in the appen claims I describe the film as being moved in the di tion of its transverse extent or the cusps as being mo along the line in which they lie, I do not exclude s ations in which the film and its cusps possess com nents of motion in other directions as well.

The speed at which my atomizer is rotated in or to obtain the benefits of the invention will depend up several factors. If the atomizer axis is vertical w the cusp-tips lying in a horizontal plane, and rotat is employed solely to effect uniformity of distributi the atomizer may rotate slowly, say at a speed o few dozen turns per minute. If the atomizer-axis is vertical and rotation is relied upon to counteract force of gravity, higher rotational speeds will be ployed; but even with the atomizer-axis horizontal a liquid of relatively low viscosity being atomized,

tendency of the liquid to collect at and near the low point of the atomizer edge can be effectively counteracted by rotating the atomizer at a speed which will subject the liquid to a centrifugal force equal at most to several times the force of gravity. It may be convenient in some cases to employ speeds higher than necessary, as where higher speeds would simplify or lessen the cost of the atomizer-rotating means.

Experiments establish that such centrifugal force as is imposed on the liquid by my rotating atomizer has far less effect than field-strength on either the degree of atomization or on the shape of the liquid spray, and that if the field has the preferred strength—i.e. an average potential-gradient of the order of 10,000 volts per inch—the speed of atomizer-rotation has no significant effect. For example, if an atomizer like that of Fig. 5 having an annular edge two inches in diameter, is positioned opposite an extended flat plate and an electrostatic field having an average gradient of 10,000 volts per inch is created between atomizer and plate, the fineness of atomization and the shape of the spray are substantially the same at 5,000 r.p.m. as they are at 200 r.p.m. But if, under the same conditions, the atomizer is rotated at a constant speed—say 1,000 r.p.m.—and the field strength is gradually reduced by lowering the potential-difference maintained between atomizer and plate, the spray begins to spread and atomization becomes much coarser, which coarser atomization can be prevented by maintaining an adequate potential gradient at the leading edge, irrespective of the polarity thereof.

I am aware that it has heretofore been proposed, as in United States Letters Patent No. 1,861,475, granted June 7, 1932, to atomize a liquid by feeding it to a rotating element driven at such a speed that the liquid is broken up into drops as it is thrown from the element by the action of centrifugal force. It is my experience, however, that in such atomizers, even when they are rotated at speeds sufficient to subject the liquid to centrifugal forces many hundred times that of gravity, the atomization is very materially coarser than that which can be produced electrostatically with a field having a potential gradient in the neighborhood of 10,000 volts per inch.

While atomizers of the type described above are especially suited for use in the application of liquid coating materials, they may have other uses. Atomization can be affected by merely creating an appropriate potential difference between the film-edge and its surroundings, as by connecting the film (or the atomizer if it is of conductive material) to one terminal of a high-voltage source the other terminal of which is grounded. Alternatively, the high-voltage source may be connected between the film-edge and an attracting electrode positioned in opposed, spaced relation to the film-edge.

This application is a continuation of and a substitute for my copending application Serial No. 143,994, filed February 13, 1950, which latter application was in turn a continuation-in-part of my earlier application Serial No. 57,259, filed October 29, 1948, and now abandoned.

I claim as my invention:

1. In a method of electrostatically spray coating the surface of an article with liquid atomized from an annular atomizing zone, the steps of flowing liquid coating material at a controlled rate from a source of supply to a rotatable head, forming it into a thin film supported on said head and advancing said supported film toward said atomizing zone by rotating the head, said film having a uniform edge of an extent many times its thickness, establishing between said film-edge and said article an electrostatic field of sufficient strength to form said film-edge into a series of spaced cusps and to electrostatically atomize finely divided discrete particles of liquid as a spray from said cusps, and electrostatically dispersing and depositing said particles on the article surface while still in liquid state, said article surface being in a substantially quiescent atmosphere and at a distance from said atomizing zone sufficient to permit substantial dispersion of the liquid spray particles as they proceed toward the article.

2. The method of claim 1, further characterized in that the film-edge is a circle.

3. A method as set forth in claim 2 further characterized in that said film is conical and flares toward its circular edge.

4. A method as set forth in claim 2 further characterized in that the liquid is fed as a stream discharging on to the head at an eccentric location spaced inwardly from the circular edge of the film.

5. A method as set forth in claim 1 further characterized in that the liquid is fed to said head at a location thereon spaced inwardly from the edge of said film.

6. A method as set forth in claim 1 further characterized in that the speed of head rotation is insufficient in itself to produce comparable atomization.

7. Apparatus for electrostatically spray coating the surface of an article with liquid atomized from an annular atomizing zone, comprising an atomizing head mounted for rotation about the axis of said atomizing zone, means for feeding liquid coating material at a controlled rate from a source of supply to said head, means for rotating said head, said head including means effective in rotation of the head for forming said liquid into a thin supported film and for providing said film with a substantially uniform leading edge at the atomizing zone, means for establishing between said film-edge and said article an electrostatic field of sufficient strength to draw the liquid of the film-edge beyond its support and form said film-edge into a series of spaced cusps, to electrostatically atomize said liquid from said cusps into a spray of finely divided discrete particles, and to disperse and deposit said particles on the article surface while still in liquid state, and means for maintaining said article surface in a substantially quiescent atmosphere and at a distance from said atomizing zone sufficient to permit substantial dispersion of the liquid spray particles as they proceed toward the article.

8. Electrostatic spray-coating apparatus as set forth in claim 7 further characterized in that said feeding means includes a conduit discharging on to said head at a location spaced inwardly from said leading film-edge.

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## EXCERPT FROM MAY 4, 1962 PROCEEDINGS, FRAMING INJUNCTION ENTERED MAY 7, 1962

THE COURT (District Court): But it doesn't matter how the head is charged. If it is done by running it through a conducting shaft to which the head is attached, or if you have a roller contact—the shaft is insulated, and you have a roller contact with the head, or if it can be done by induction, or if it can be done by prayer, what difference does it make as long as the head is charged?

MR. LAWRENCE (representing respondent): I think that is true.

THE COURT: So I think that the word "directly" is probably too limited, and I think that Mr. Hume is correct in his reference to the word "grounded," that it doesn't matter whether the head is at ground potential and the object is at the opposite potential or not.

MR. LAWRENCE: I agree with that.

## EXCERPT FROM RESPONDENT'S (IONIC) BRIEF ON APPEAL IN CONTEMPT PROCEEDING (PAGES 18-19)

If, as plaintiff claimed, the paint on the uncharged atomizer heads of the Models 10, 25 and 30 devices is electrostatically atomized, it would have been exceedingly easy for plaintiff to prove it, and it would not have required a twelve day contempt hearing.

In order for paint to electrostatically atomize, there must be a field existing between the atomizer head and the object to be coated of sufficient strength and of sufficient concentration about the head to effect such electrostatic atmoziation. In the previous models in which the head was charged, the existence of a field of such strength and concentration

was easily proven by visual evidence of electrostatic atomization. With the normal supply of paint fed to the head, the head was rotated at a low speed below centrifugal atomizing speed and the electrical current source to the head was disconnected. With no charge on the head, the paint flew off in large gobs. When the electrical current source was then applied to the head, the paint began to electrostatically atomize in the form of fine droplets. Even the defendant conceded that this was electrostatic atomization at these low rotational speeds, and it was conclusive to the Trial Judge.

If the same low speed observations had been demonstrated by plaintiff in the contempt proceedings, these proceedings would have been immediately concluded. The new models would have been established as equivalents of the old models, and would have appropriated the advantages of plaintiff's inventions.